SELECTED WATER RESOURCES ABSTRACTS

VOLUME 3, NUMBER 21
NOVEMBER 1, 1970

W70-08585 -- W70-09010

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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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03 WATER SUPPLY AUGMENTATION AND CONSERVATION
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05 WATER QUALITY MANAGEMENT AND PROTECTION
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10 SCIENTIFIC AND TECHNICAL INFORMATION
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ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1A. Properties

INVESTIGATION OF ANOMALOUS WATER,
Lowell Technological Inst. Research Foundation, Mass.
Bela M. Fabuss, Alexander Dolman, Robert Suslavich, and Demetrios Kekis.
For sale by Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price $0.45. US Office of Saline Water Research and Development Progress Report No 558, 1970. 33 p, 10 fig, 2 tab, 20 ref. Contract No 14-01-0001-2096 OSW.

Descriptors: *Water structure, *Water properties, Hydrogen bonding, Thermodynamic behavior, Viscosity, Melting, Freezing, Boiling, Laboratory tests.
Identifiers: *Anomalous water, Polywater.

The preparation and certain properties of anomalous water were investigated. Anomalous water was formed in quartz and Pyrex capillaries, particulate beds, and on flat plates. Samples as large as 3 mg were made in a single operation. A quantitative expression was given to express the anomality of a given sample on the basis of its expansion characteristics. The formation of anomalous water and its relative stability were explained on the basis of regular solution thermodynamics. Highly hydroxylated surfaces are required for its attachment and formation. Most anomalities can be explained by an excess of nonhydrogen-bonded close-packed structure in the water. The entirely anomalous water represents this structure without the presence of an ice-like hydrogen-bonded structure. This explains phenomena such as the expansion characteristics and phase behavior, and gives information in regard to formation and preparation. (Knapp-USGS)
W70-08977

THE EFFECT OF SOME SUBSTANCES ON THE COEFFICIENT OF CONDENSATION OF WATER DROPS,
B. M. Shinyayev.
For sale by Clearinghouse, Springfield, Va. - Price $3.00. Transl from 'Problemy Fiziki Atmosfery. Sbornik 5.' Leningrad State Univ Press, 1967. In: Problems of Atmospheric Physics, Collection 5, National Aeronautics and Space Administration Technical Translation Report NASA TT F-587, p 256-260, June 1970. 5 p, 1 fig, 1 tab, 11 ref.

Descriptors: *Condensation, *Evaporation, *Evaporation control, *Surfactants, Soaps, Surface tension, Water chemistry, Water properties, Solutes, Aqueous solutions.
Identifiers: Surfactant effects.

The coefficient of condensation of water drops is examined in relation to three substances; sodium laurate, sodium palminate and isoamyl alcohol. It is assumed that the nature of the effect of molecules of soluble surface-active solutions on the evaporation differs basically from the characteristics of surface films of nonsoluble surface active substances. (Knapp-USGS)
W70-09009

1B. Aqueous Solutions and Suspensions

INVESTIGATION OF ANOMALOUS WATER,
Lowell Technological Inst. Research Foundation, Mass.
For primary bibliographic entry see Field 01A.
W70-08977

THE EFFECT OF SOME SUBSTANCES ON THE COEFFICIENT OF CONDENSATION OF WATER DROPS,
For primary bibliographic entry see Field 01A.
W70-09009

02. WATER CYCLE

2A. General

WATER BALANCE IN NORTH AMERICA,
Arleigh H. Laycock, Martha Francisco, and Thelma Fisher.
Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association publication, Urbana, Illinois, 2969. 335 p.

Descriptors: *Conferences, *Water balance, *Regions, *United States, Hydrologic budget, Hydrologic cycle, Rainfall-runoff relationships, Surface-groundwater relationships.
Identifiers: *Canada, *North America.

The water balance of North America was discussed in a symposium of 8 sections comprising 34 papers. The topics of the sections are: regional water balance patterns; local patterns; streamflow and groundwater; water balance modifications (regime and quality, yield increase, utility increase, and legal responsibility); research programs, and research needs. (Knapp-USGS)
W70-08597

THE AVERAGE ANNUAL WATER BALANCE OF THE WORLD,
Delaware Univ., Newark. Dept. of Geography, and Thornthwaite (C. W.) Associates, Elmer, N. J.
John R. Mather.
Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association publication, Urbana, Illinois, p 29-40, 1969. 12 p, 2 fig, 7 tab, 15 ref.

Descriptors: *Water balance, *Hydrologic cycle, Runoff, Streamflow, Rainfall-runoff relationships, Climatology, Weather, Climates, Precipitation (Atmospheric), Mapping.
Identifiers: World water balance.

World maps of annual precipitation prepared by Geiger were analyzed to provide average annual values by 10 degree squares of latitude and longitude as well as by continent and ocean areas. The depth of runoff is greatest from South America, followed by Asia, Europe and North America in that order. Runoff from the North American continent is below the average from all continental land masses. New figures for global precipitation and evapotranspiration are utilized to evaluate the average annual hydrologic cycle. The results emphasize the small influence of local evapotranspiration in local precipitation. Quantitative estimates are mode of the mobility of moisture from oceans to land and back again in the atmosphere. (Knapp-USGS)
W70-08598

AN AVERAGE WATER BALANCE FOR CANADA,
Windsor Univ. (Ontario).
Marie E. Sanderson.
Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association publication, Urbana, Illinois, p 41-54, 1969. 14 p, 9 fig, 8 ref.

Descriptors: *Water balance, *Regions, Climatology, Weather, Precipitation (Atmospheric), Runoff, Rainfall, Evapotranspiration, Gaging stations, Maps, Mapping, Streamflow, Hydrologic cycle, Hydrologic budget.
Identifiers: *Canada.

If long term average conditions are assumed, an annual water balance equation can be written for Canada. The average parameters in Canada's water balance are presented on maps. Such maps are tentative, based, except along Canada's southern border, on inadequate data. The precipitation map is based on average precipitation figures from some 2,000 Department of Transport climatic stations. Amounts of potential and actual evapotranspiration and water deficiency are obtained by the Thornthwaite water balance method assuming an average water holding capacity of the soil. The runoff maps are based on stream gaging data complemented by climatically determined figures of water surplus. Some estimates of volumes of runoff are obtained by planimetry. (Knapp-USGS)
W70-08599

WATER BALANCE PATTERNS IN THE CONTINENTAL UNITED STATES,
Geological Survey, Menlo Park, Calif.
John R. Crippen.
Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association publication, Urbana, Illinois, p 55-61, 1969. 7 p, 2 fig, 1 tab, 5 ref.

Descriptors: *Water balance, *Water utilization, *United States, Rainfall-runoff relationships, Irrigation water, Municipal water, Industrial water, Discharge (Water), Streamflow, Runoff, Evapotranspiration.
Identifiers: U.S. water balance.

The conterminous United States receives as annual precipitation about 1,430 cubic miles of water. Of this, about 392 cubic miles leaves the national boundaries by entering the sea or by river outflow to other nations. Average precipitation ranges from 3 or 4 inches annually in desert valleys of the southwest to well over 120 inches in coastal mountains of the northwest. The one-third of the nation east of the Mississippi River receives everywhere more than 30 inches of precipitation annually. Average annual runoff to the Pacific Ocean is about 92 cubic miles, to the Gulf of Mexico about 191 cubic miles, and to the Atlantic Ocean or its tributaries about 109 cubic miles. Deficiencies occur most frequently in the agricultural regions of the southwest, where the annual precipitation is highly variable and irrigation practices require large quantities of water for use over large areas. Deficiencies in the eastern part of the country usually affect smaller regions where there is concentrated industrial or domestic use; therefore the greatest impact of shortages is upon the major metropolitan centers, particularly those in the densely settle coastal region from Boston, Mass., to Washington, D.C. (Knapp-USGS)
W70-08600

INSTRUMENTATION AND OBSERVATION TECHNIQUES.
For primary bibliographic entry see Field 07B.
W70-08611

REVIEW HYDROMETEOROLOGICAL INSTRUMENTATION,
Department of Transport, Toronto (Ontario). Meteorological Branch.
For primary bibliographic entry see Field 07B.
W70-08612

RADAR AS A REMOTE SENSOR FOR HYDROLOGY,
McGill Univ., Montreal (Quebec). Dept. of Physics.
For primary bibliographic entry see Field 02B.
W70-08625

STATUS OF PILOT WATERSHED STUDIES IN ARIZONA,
Forest Service (USDA), Flagstaff, Ariz.
For primary bibliographic entry see Field 03B.
W70-08946

STORAGE AND HYDROLOGIC PROCESSES,
Saskatchewan Univ., Saskatoon. Div. of Hydrology.
Don M. Gray, and D. I. Norum.
In: Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association, Urbana, Illinois, p 151-162, 1969. 4 fig, 16 ref.

Descriptors: *Water storage, *Surface-groundwater relationships, *Rainfall-runoff relationships, Time lag, Routing, Soil moisture, Soil water, Groundwater, Surface waters, Groundwater movement, Water balance, Hydrogeology, Infiltration, Evapotranspiration.
Identifiers: *Basin yield.

The influence of the storage component on individual hydrologic processes in the water balance equation is discussed. Soil moisture content affects: (a) the time-variation, the depth and volume of infiltration and (b) the time-rate, distribution and amount of evapotranspiration by a given crop. Details are presented of the techniques and methodology to quantitatively evaluate the effect of soil moisture storage on these processes. Storage is also important to surface and groundwater flow systems. Particular emphasis is placed on the modulating and attenuating effect of storage on both peak flows and basin yield. Flow may be considered as a simple input-output system. Examples are given to demonstrate the effect of lag-time in simple mass balance or water balance equations. Additional discussions are directed to field methods of evaluating storage in these systems. (See also W70-08597)
W70-08987

RECOVERY OF POLLUTED WATER,
Ontario Water Resources Commission, Toronto. Great Lakes Water Quality Surveys Program.
For primary bibliographic entry see Field 05G.
W70-08988

PHYSIOGRAPHY-LAND USE INTERACTIONS IN WATERSHED MANAGEMENT,
British Columbia Univ., Vancouver. Dept. of Forestry.
For primary bibliographic entry see Field 05B.
W70-08989

URBANIZATION AND THE WATER BALANCE,
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 04C.
W70-08990

VEGETATION MANAGEMENT FOR WATER YIELD,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 03B.
W70-08991

CLOUD SEEDING AND RAIN MAKING,
Alberta Univ., Edmonton. Dept. of Meteorology.
For primary bibliographic entry see Field 03B.
W70-08992

SOME RECENT RESEARCH IN EVAPORATION SUPPRESSION,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 03B.
W70-08993

PRIME-ALBERTA'S BLUEPRINT FOR WATER DEVELOPMENT,
Department of Agriculture, Edmonton (Alberta). Water Resources Div.
For primary bibliographic entry see Field 06B.
W70-08994

POTENTIAL EFFECTS OF SPRINKLED AGRICULTURE ON THE NORTH AMERICAN WATER BALANCE,
California Univ., Davis. Dept. of Agricultural Economics.
David William Seckler.
In: Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association, Urbana, Illinois, p 235-242, 1969. 1 tab.

Descriptors: *Water resources development, *Water conservation, *Water balance, *Sprinkler irrigation, Sprinkling, Water demand, Water utilization, Irrigation practices, Water consumption, Consumptive use, Water management (Applied).
Identifiers: North America.

Sprinkler irrigation constitutes 15 percent of the irrigated acreage of the western United States and is growing at an annual rate of 13 percent. This trend is likely to continue in the foreseeable future because of the profitability of sprinkler irrigation to agricultural firms. Because of the substantial savings in water under sprinkler irrigation, water coefficients used for planning future agricultural development in the western United States must be substantially reduced. The possibility of converting presently furrow-irrigated land to sprinkler systems, together with modern techniques of efficient furrow irrigation, may create sufficient water conservation to eliminate the need for large-scale water development in the foreseeable future. (See also W70-08597)
W70-08995

MODIFYING THE WATER BALANCE BY DESALINATION,
Geological Survey, Washington, D.C.; and Office of Saline Water, Washington, D.C.
For primary bibliographic entry see Field 03A.
W70-08996

IS WATER DIFFERENT,
Department of Energy, Mines and Resources, Ottawa (Ontario). Policy and Planning Branch.
For primary bibliographic entry see Field 06C.
W70-08997

PRELIMINARY EVALUATION OF THE WATER BALANCE IN THE CENTRAL AMERICAN ISTHMUS,
Leif Ahlgren, Eduardo Basso, and Roberto Jovel.
In: Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association, Urbana, Illinois, p 288-298, 1969. 5 fig, 19 ref.

Descriptors: *Water balance, *Regions, Hydrologic budget, Hydrologic cycle, Rainfall-runoff relationships, Evapotranspiration, Precipitation (Atmospheric), Streamflow, Groundwater movement, Runoff.
Identifiers: Central America.

Existing hydrologic and meteorologic data, although limited in quantity and quality, have enabled the preparation of a first preliminary quantitative evaluation of the hydrologic cycle for the Central American Isthmus. A detailed isohyetal map, covering the 1938-1967 hydrologic time period was prepared for the study area. Annual rainfall rates were found to range between more than 5000 millimeters in certain localized areas of central Costa Rica and Guatemala, and less than 1000 millimeters in Honduras and Guatemala. Pronounced dry periods occur, which has a direct influence on the distribution of runoff and on the amount of water consumed by permanent vegetation and crops. About 45 percent of the total rainfall runs off on the surface to the oceans, 48 percent is consumed by transpiration and evaporation, 7 percent flows out to the oceans through subsurface media. (See also W70-08597)
W70-09000

WATER INVENTORY STUDIES IN THE UNITED STATES AND THE I.H.D. PROGRAM,
National Committee for the International Hydrological Decade, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-09001

CANADIAN RESEARCH,
National Committee for the International Hydrological Decade, Ottawa (Ontario).
For primary bibliographic entry see Field 02E.
W70-09002

UNITED STATES WATER RESOURCES RESEARCH NEEDS,
Illinois Univ., Urbana. Coll. of Agriculture.
For primary bibliographic entry see Field 09C.
W70-09003

2B. Precipitation

THE AVERAGE ANNUAL WATER BALANCE OF THE WORLD,
Delaware Univ., Newark. Dept. of Geography, and C. Thornthwaite (C. W.) Associates, Elmer, N. J.
For primary bibliographic entry see Field 02A.
W70-08598

AN AVERAGE WATER BALANCE FOR CANADA,
Windsor Univ. (Ontario).
For primary bibliographic entry see Field 02A.
W70-08599

SOME CURRENT STUDIES OF LOCAL PRECIPITATION VARIABILITY OVER WESTERN CANADA,
Department of Transport, Toronto (Ontario). Meterorological Branch.
H. L. Ferguson, and D. Storr.
Preceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association publication, Urbana, Illinois, p 80-100, 1969. 21 p, 15 fig, 1 tab, 23 ref.

Descriptors: *Distribution patterns, *Precipitation (Atmospheric), *Regions, Rain gages, Networks, Gaging stations, Water balance, Hydrologic budget, Runoff, Rainfall-runoff relationships.
Identifiers: *Canada.

The accuracy of areal estimates of precipitation for use in water balance calculations is discussed. Estimates from point measurements are subject to large errors due to problems of instrument design and siting. Areal variability is related to the form of precipitation, topographical factors, and whether the precipitation is of a showery or steady type. Some results of current Canadian studies are presented to illustrate these points. The error of estimate of areal precipitation over a given region is a function of network density and the accumulation period. This relationship is examined for two large areas, Southern Saskatchewan and the Lower Great Lakes-Upper St. Lawrence area. A map is presented showing the standard precipitation network density across Canada. (Knapp-USGS)
W70-08602

REVIEW HYDROMETEOROLOGICAL INSTRUMENTATION,
Department of Transport, Toronto (Ontario). Meteorological Branch.
For primary bibliographic entry see Field 07B.
W70-08612

AUTOMATIC CLIMATOLOGICAL RECORDING STATIONS IN REMOTE AREAS,
McGill Univ., Montreal (Quebec).
F. Muller.

Proceedings of Canadian Hydrology Symposium No 7, Victoria, British Columbia, scheduled for May 14u15, 1969; held Oct 8-9, 1969, National Research Council of Canada, Subcommittee on Hydrology, p 205-217, Vol 1, 1969. 13 p, 3 fig, 2 tab, 8 ref.

Descriptors: *Logging (Recording), *Data collections, *Meteorological data, *Climatic data, Telemetry, Arctic, Cold regions, Rain gages, Precipitation gages, Snowfall, Temperatures, Winds, Humidity, Solar radiation.
Identifiers: Canada, Air pressure.

Some experience with two types of automatic climatological stations, established in a glacierized basin of the Canadian High Arctic, is presented as an example of one of their many applications in remote areas. Some other designs are also reviewed, and the need for further development of protection against the severity of the environment is stressed. (Knapp-USGS)
W70-08617

HYDROMETEOROLOGICAL AUTOMATIC TELEMETERING STATIONS,
Meteorological Service of Canada, Toronto (Ontario).
H. C. Belhouse, D. W. Colwell, and J. S. Dickson.
Proceedings of Canadian Hydrology SYMPOSIUM No 7, Victoria, British Columbia, scheduled for May 14-15, 1969; held Oct 8-9, 1969, National Research Council of Canada, Subcommittee on Hydrology, p 189-203, Vol 1, 1969. 15 p, 5 fig.

Descriptors: *Telemetry, *Data transmission, *Data collections, *Hydrologic data, Meteorological data, Instrumentation, Design, Network design, Equipment, Research and development, Precipitation gages, Stream gages, Water levels, Columbia River Basin.
Identifiers: Canada.

The activities of the Canadian Meteorological Branch in the field of hydrometeorological automatic telemetering stations, particularly in respect to those stations required at remote mountain locations in the Columbia Basin are reviewed. The course of events is pursued from initial experiments to assess the challenge of this formidable Canadian environment, through the design evolution stage of repeated development and mountain testing, to the current stage of a working model that now withstands the environment and provides a substantial performance capability. Unsuccessful design approaches are recounted to identify what appear to be blind alleys, and the more promising direction and applications of final prototype equipment are suggested. (Knapp-USGS)
W70-08618

APPLICATIONS OF SATELLITE PHOTOGRAPHS TO HYDROLOGY IN CANADA,
Department of Transport, Toronto (Ontario). Meteorological Branch.
H. L. Ferguson, H. F. Cork, and A. D. J. O'Neill.
Proceedings of Canadian Hydrology Symposium No 7, Victoria, British Columbia, scheduled for May 14-15, 1969p held Oct 8-9, 1969, National Research Council of Canada, Subcommittee on Hydrology, p 311-343, Vol 1, 1969. 33 p, 11 fig, 4 tab, 36 ref.

Descriptors: *Satellites (Artificial), *Aerial photography, *Hydrologic data, *Surveys, Water resources, Snow surveys, Meteorology, Hydrogeology, Glaciers, Thawing, Mapping.
Identifiers: Canada.

The latest developments in weather satellite technology and the application of satellite photographs to hydrology are reviewed. A comparison of satellite observations versus conventional observations over Canada is made, based on data collected over at least one winter. This comparison deals specifically with basin snow cover, large scale snow-line observations and the break-up and freeze-up of large lakes. Weather satellite photographs are available in Canada on a routine basis and provide up-to-date pictures of the earth's surface as well as of cloud formations. While the photographs are used in many countries for weather analysis and forecasting, routine use of this new data source for hydrological purposes is still in the research and development stage. (Knapp-USGS)
W70-08622

RADAR AS A REMOTE SENSOR FOR HYDROLOGY,
McGill Univ., Montreal (Quebec). Dept. of Physics.
J. S. Marshall, and P. E. Carlson.
Proceedings of Canadian Hydrology Symposium No 7, Victoria, British Columbia, scheduled for May 14-15, 1969; held Oct 8-9, 1969, National Research Council of Canada, Subcommittee on Hydrology, p 261-281, Vol 1, 1969. 21 p, 9 fig, 1 tab, 11 ref.

Descriptors: *Remote sensing, *Precipitation (Atmospheric), *Radar, Synoptic analysis, Distribution patterns, Rainfall disposition, Weather, Climatology, Data collections, Weather patterns, Mapping.
Identifiers: Canada.

Radar yields a map over a large area, for a layer of atmosphere above the earth's surface, of the Radar parameter Z. There is a statistical relationship between Z and R, the rate of precipitation. For any single point on the map, radar can measure R to within 25 percent, and there is an uncertainty of 50 percent in the relation of Z to R. Expanding from a point to an area, performance improves considerably. Also, expanding from rate at an instant to amount over a period of time improves performance. Apart from use as a gage radar can give a very detailed qualitative pattern. (Knapp-USGS)
W70-08625

CONTENT OF TRACE ELEMENTS IN PRECIPITATION,
Main Geophysical Observatory, Liningrad (USSR); and Institute of Experimental Meteorology, Obninsk (USSR).
V. M. Drozdova, and E. P. Makhon'ko.
Journal of Geophysical Research, Vol 75, No 18, p 3610-3612, June 20, 1970. 2 tab, 12 ref.

Descriptors: *Trace elements, *Chemistry of precipitation, *Precipitation (Atmospheric), Sampling, Data collections, Manganese, Iron, Spectroscopy, Distribution patterns.
Identifiers: Nickel, Lead, USSR.

Seventy-five combined monthly precipitation samples collected in 1968-1969 at stations in the north, northwest, and central regions of the European territory of the Soviet Union were analyzed. Annually averaged maximum and minimum concentrations of manganese, nickel, lead, and iron in precipitation are given, as well as mean concentrations of the same elements during cold and warm periods for regions of the European territory of the USSR. (Knapp-USGS)
W70-08940

MODEL FOR CAPTURE OF RADIOACTIVITY BY PRECIPITATION,
Institute of Experimental Meteorology, Obninsk (USSR).
A. S. Avramenko, and K. P. Makhon'ko.
Journal of Geophysical Research, Vol 75, No 18, p 3613-3622, June 20, 1970. 8 fig, 21 ref.

Descriptors: *Radioisotopes, *Precipitation (Atmospheric), *Mathematical models, *Fallout, *Chemistry of precipitation, Dusts, Cloud physics, Sampling, Particle size.
Identifiers: Rainout chemistry.

A rough scheme for radioactive dust particle capture by rain droplets is presented. Processes taking place both within the cloud with regular updrafts and in the layer of the atmosphere below the cloud that lead to a definite distribution of specific radioactivity with droplet size are considered. Comparison of experimental data on the fission-product concentration in raindrops of different sizes with theoretical calculations allowed determination of the coefficient of rainout for removal of radioactive particles by cloud drops, corresponding to an inverse proportionality between concentration and cloud drop radius. The functional dependence obtained theoretically is in good agreement with the experimental data. The influence of the specific radioactivity distribution versus droplet size on the variation of the specific radioactivity during a short-range shower is considered. (Knapp-USGS)
W70-08941

STRONTIUM 90 FALLOUT DISTRIBUTION AT MIDDLE LATITUDES OF THE NORTHERN AND SOUTHERN HEMISPHERES AND ITS RELATION TO PRECIPITATION,
Institute of Experimental Meteorology, Obninsk (USSR). Hydrometeorological Service.
S. G. Malakhov, and I. B. Pudovkina.
Journal of Geophysical Research, Vol 75, No 18, p 3623-3628, June 20, 1970. 5 fig, 3 tab, 3 ref.

Descriptors: *Fallout, *Chemistry of precipitation, *Data collections, *Strontium radioisotopes, Sampling, Precipitation (Atmospheric), Synoptic analysis, Data collections, Mathematical models, Statistical models.
Identifiers: Radiological networks, USSR.

The dependence of Sr-90 deposition on precipitation within each 10 deg latitude belt was investigated. No satisfactory linear correlation was found for undifferentiated measurements obtained under different climatic conditions. Regions in which the data deviate systematically from the general trend of results in each latitude belt are singled out. A satisfactory linear correlation for most of the data was obtained between 50 and 60 deg N and for the first and second quarters between 30 and 40 deg N and 40 and 50 deg N. The third quarter is characterized by the largest deviations of the results from a linear dependence. The regression equations for the dependence of Sr-90 deposition on precipitation in each latitude belt are given. (Knapp-USGS)
W70-08942

THE POSSIBILITY OF INTERPRETING THE DATA OF A SEDIMENTATION ANALYSIS,
M. M. Kokhanovich, and V. G. Morachevskiy.
For sale by Clearinghouse, Springfield, Va - Price $3.00. Transl from 'Problemy Fiziki Atmosfery Sbornik 5.' Leningrad State Univ Press, 1967. In: Problems of Atmospheric Physics, Collection 5, National Aeronautics and Space Administration Technical Translation Report NASA TT F-587, p 261-264, June 1970. 4 p, 4 fig, 6 ref.

Descriptors: *Precipitation (Atmospheric), *Raindrops, *Cloud physics, *Statistical methods, *Microscopy, Photography, Analytical techniques, Model studies, Statistical models.
Identifiers: Water-drop sedimentation.

A study was made of the distribution of drops in modeled nebula obtained by a sedimentation analysis and by the microphotographic method. The sedimentation method of analyzing the degree of dispersion of a modeled nebula gives a completely clear and precise representation of the distribution of drops by size. (Knapp-USGS)
W70-09010

2C. Snow, Ice, and Frost

GLACIER DISCHARGE SIMULATION,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
A. L. Derikx.
Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association publication, Urbana, Illinois, p 143a, 1969. 1 p.

Descriptors: *Simulation analysis, *Glaciers, *Ablation, *Water yield, *Streamflow forecasting, Water balance, Melting, Precipitation (Atmospheric), Percolation, Runoff, Energy budget, Synthetic hydrology, Mathematical models.
Identifiers: Glacier discharges, Canada.

The flow of water from glacier drainage basin is defined by differential equations with boundary conditions similar to those of non-steady groundwater flow. Field data from Peyto Glacier, Alberta, Canada, are analyzed. In the heat balance only four terms have been considered: net radiation flux, sensible heat flux, latent heat flux and the heat available for melting snow and ice. The glacier is regarded as a lumped, linear system and meltwater is considered to percolate into this reservoir. The computation of outflow rates follows methods for non-steady groundwater flow to parallel drains based on the linearized Boussinesq's equation. One single parameter, defined as 'reservoir coefficient,' incorporates all hydrological properties of the glacier drainage situation. The principle of superimposition can be used to compute variations of outflow rate caused by variation of percolation. (Knapp-USGS)
W70-08608

2D. Evaporation and Transpiration

EVAPORATION IN TENNESSEE RIVER BASIN, 1935-1969.
Tennessee Valley Authority, Knoxville.

Tennessee Valley Authority Hydraulic Data, Branch Report No 0-6862, May 1970. 59 p, 2 plate, 4 tab.

Descriptors: *Evaporation, *Tennessee Valley Authority Project, Evaporation pans, Climatology, Data collections, Hydrologic data, Water balance.
Identifiers: Tennessee River Basin.

During the 35-year period 1935 through 1969, the Hydraulic Data Branch of the Tennessee Valley Authority observed daily evaporation and associated data at several land-pan stations in the Tennessee River Basin. Records of these observations are given in this report. Observations are made once daily between 7 and 8 a.m. during the months of April through October and between 4 and 5 p.m. during the period November through March. The afternoon observation time during the winter was set to permit natural melting of ice that covers the pan on cold mornings. The variation in mean annual evaporation from one end of the Valley to the other averages about 10 inches. The highest evaporation, 46 to 53 inches, occurs in the western part of the Valley and the lowest, 38 to 40 inches, in the North Carolina mountains. Evaporation in the east-central portion, as measured at the Norris and Jefferson City stations, is between these two limits. The principal difference in factors affecting evaporation is wind velocity. (Knapp-USGS)
W70-08586

WATER BALANCE IN NORTH AMERICA,
For primary bibliographic entry see Field 02A.
W70-08597

AN AVERAGE WATER BALANCE FOR CANADA,
Windsor Univ. (Ontario).
For primary bibliographic entry see Field 02A.
W70-08599

LOCAL VARIATION IN EVAPOTRANSPIRATION,
British Columbia Univ., Vancouver. Dept. of Forestry.
Bertram C. Goodell.
Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association publication, Urbana, Illinois, p 110-115, 1969. 6 p, 12 ref.

Descriptors: *Evapotranspiration, *Distribution patterns, Topography, Winds, Meteorology, Climates, Precipitation (Atmospheric), Vegetation effects. Soil properties, Water storage, Soil water, Water balance, Advection, Consumptive use, Energy budget, Environmental effects.
Identifiers: Aerodynamic roughness.

Rate of evapotranspiration depends on the degree of confluence in time and space of three variables: water availability, energy supply, and surface ventilation. Within a topographically and vegetatively rough landscape, such as a typical watershed, each of these variables varies widely. Water availability is a function of precipitation characteristics, both temporal and spatial, as well as soil and vegetation characteristics as they affect storage. Local variations in energy supply are largely topography, vegetation and soils. Ventilation is a function of topographic position and surface roughness. Spatial variation in factors causative of evapotranspiration render its accurate evaluation impossible by present methods. Current reliance must be placed on approximations and relative magnitude evaluations. Several approaches to these are reviewed. (Knapp-USGS)
W70-08604

LOCAL VARIATIONS IN THE WATER BALANCE: GEOLOGIC FACTORS,
University of Western Ontario, London. Dept. of Geology.
Robert N. Farvolden.
Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association publication, Urbana, Illinois, p 116-121, 1969. 6 p, 20 ref.

Descriptors: *Water balance, *Hydrogeology, *Geology, Surface-groundwater relationships, Aquifers, Groundwater basins, Groundwater movement, Discharge (Water), Evapotranspiration, Permeability, Transmissivity, Recharge, Water storage.
Identifiers: Inter-basin groundwater flow, North America.

The items in the water-balance equation that are most influenced by sub-surface geology are interbasin movement of groundwater and evapotranspiration. Interbasin flow of groundwater can be expected in any region underlain by highly permeable materials and it can be easily recognized where water table contours do not match the surface topography. Analytical techniques for the solution of these flow systems are now available. The pertinent parameters are the distribution and properties of the hydrostratigraphic units in the sub-surface, the geometry of the system, and the configuration of the water table. Subsurface geology has an important influence on evapotranspiration loss where it is the factor responsible for maintaining a high water table, particularly during long droughts, because evapotranspiration rate varies considerably according to the depth of the water table. Favorable conditions occur wherever shallow, river-connected aquifers support a heavy cover of phreatophytes and in areas of groundwater discharge. (Knapp-USGS)
W70-08605

WATER UPTAKE BY ORCHARDGRASS AN EVAPORATION FROM BARE SOIL IN TH PRESENCE OF SHALLOW WATER TABLES,
Department of Agriculture, Lethbridge (Alberta) Research Station.
J. C. van Schaik, and K. K. Krogman.
Canadian Journal of Soil Science, Vol 48, No 3, p 281-288, October 1968. 2 fig, 1 tab, 9 ref.

Descriptors: *Orchardgrass, *Moisture uptake *Evapotranspiration, *Soil moisture, *Saline soils Water table, Water level, Evaporation, Moisture content, Water loss, Grasses, Forage grasses Semiarid climates, Transpiration, Fallowing, Soil surfaces.
Identifiers: *Alberta (Canada), *Salinization *Bare fallow, Potential evapotranspiration.

Studies from June 16 to September 15, 1967 with 12 non-weighing lysimeters showed that orchardgrass (Dactylis glomerata) ET was 38.8 37.2, and 34.9 cm with water tables at depths of 91, 122, and 152 cm, respectively. The measured ET due almost entirely to transpiration, represented 60 percent of the estimated potential ET. Surface salt concentration was not influenced by evaporation from bare soil in 1967. Barring fluctuation of the water table, salinization of cropped soil should principally occur outside the growing season. Since salinization would not take place without plant cover, use of bare fallow should retard salt movement and salinization of surface soil. (Carr-Arizona)
W70-08820

THERMAL LOADING IN DUNKIRK HARBOR,
State Univ. Coll., Fredonia, N.Y.
For primary bibliographic entry see Field 05B.
W70-08838

SOME RECENT RESEARCH IN EVAPORATION SUPPRESSION,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 03B.
W70-08993

2E. Streamflow and Runoff

DRAINAGE AREAS FOR STREAMS IN TENNESSEE RIVER BASIN.
Tennessee Valley Authority, Knoxville.

Tennessee Valley Authority, Hydraulic Data Branch Report No 0-5829-R-2, March 1970. 116 p, 2 plate, 16 tab.

Descriptors: *Tennessee Valley Authority Project, *Watersheds (Basins), *Size, *Areal, Dimensions, Mapping, Maps, Surfaces.
Identifiers: *Tennessee River Basin, Drainage areas.

Drainage areas range in size from a few acres to 40,910 square miles in the Tennessee River Basin. Drainage areas for streams were measured on TVA planimetric and topographic maps, scale 1 inch = 2000 feet. An index of all sites in alphabetical order of stream name shows watershed and page reference. (Knapp-USGS)
W70-08588

WATER BALANCE IN NORTH AMERICA,
For primary bibliographic entry see Field 02A.
W70-08597

WATER BALANCE PATTERNS IN THE CONTINENTAL UNITED STATES,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02A.
W70-08600

STREAMFLOW DISTRIBUTION PATTERNS IN MEXICO,
Secretariat of Hydraulic Research (Mexico); and Geological Survey, Tucson, Ariz.
Fernando del Rio, and Alfonso Wilson.
Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association publication, Urbana, Illinois, p 62-73, 1969. 12 p, 8 fig, 2 tab, 9 ref.

Descriptors: *Water balance, *Regions, Hydrologic budget, Precipitation (Atmospheric), Rainfall, Rainfall-runoff relationships, Streamflow, Runoff, Evapotranspiration, Irrigation water.
Identifiers: *Mexico.

Half of Mexico lies in the temperate and half in the intertropical zone. Mountain ranges parallel the two coasts, and an intermontane plateau occupies almost the entire intervening area. Arid and semiarid regions comprise almost two-thirds of the country's 2-million odd square kilometers. True desert occupies only 4 percent of the area, while 7 percent is humid or very humid. Winter frontal precipitation is relatively unimportant. Summer precipitation occurs as short, intense storms. Even where annual precipitation appears abundant, it occurs mostly during the non-growing season. Annual precipitation ranges from almost zero to 5,000 mm and averages 704 mm. The total volume of precipitation is 1,408 billion cu m. The total runoff to the sea and to international streams is 349.5 cu m. Surface runoff amounts to only 25% of precipitation and loss to evapotranspiration is 75% of precipitation. The net volume of water used in irrigation is about 1 1/2% of the precipitation and about 6% of the runoff. (Knapp-USGS)
W70-08601

HYDROMETRIC SURVEYS,
Shawinigan Engineering Co. Ltd., Montreal (Quebec).
S. I. Solomon.
Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association publication, Urbana, Illinois, p 125-136, 1969. 12 p, 1 fig, 3 tab, 7 ref.

Descriptors: *Hydrologic data, *Hydrography, *Data collections, *Surveys, *Networks, Regions, Gaging stations, Water balance, Meteorological data, Distribution patterns, Surface waters, Groundwater, Soil water.
Identifiers: Hydrometric surveys, North America.

From about 12,000 gaging stations which are or have been in operation in North America, it is now possible to draw at least an approximate picture of the average water availability and to roughly estimate other hydrologic characteristics. However, because of the extreme variation in network density and the vastness and variety of the terrain, there are areas with inadequate hydrometric coverage. A similar situation exists for the meteorologic networks which to a large extent have been developed independently of the hydrometric networks, but followed a similar pattern. Further expansion of the present network therefore appears imperative in some areas, while reduction of the density may be possible in other areas. The use of computers, satellites, and other related technological development will facilitate the collection, processing, and retrieving of hydrologic information in a more comprehensive way than in the past. (Knapp-USGS)
W70-08606

AREAL EXTENSION OF STREAMFLOW INFORMATION BY MULTIPLE-REGRESSION TECHNIQUES,
Geological Survey, Washington, D.C. Surface Water Branch.
Manuel A. Benson, and Rolland W. Carter.
Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association publication, Urbana, Illinois, p 137-143, 1969. 7 p, 2 fig, 1 tab.

Descriptors: *Streamflow forecasting, *Hydrologic data, *Data processing, *Regression analysis, Statistical methods, Gaging stations, Networks, Surveys, Streamflow, Discharge (Water), Planning, Water resources development, Data collections.
Identifiers: Multiple regression analysis.

Definition of the natural streamflow in all streams, gaged or ungaged, is one of the principal objectives of a streamflow information program. Multiple regression analyses are used to provide general definition of natural streamflow. The streamflow characteristics that may be generalized are used in planning and design; they are indices of high, low and medium flows, and also of the distribution of flows in time. Numerous topographic and climatic indices are used to describe the watershed and its environment above the site of each flow record. Multiple regression analyses then relate each flow characteristic to the effective basin characteristics. The result is in the form of generalized equations for estimating flow characteristics at any site, gaged or ungaged. The analyses also provide measures of the accuracy of each relation. Examples are given of results of such studies. (Knapp-USGS)
W70-08607

INSTRUMENTATION AND OBSERVATION TECHNIQUES.
For primary bibliographic entry see Field 07B.
W70-08611

SURFACE WATER,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
E. R. Peterson.
Proceedings of Canadian Hydrology Symposium No 7, Victoria, British Columbia, scheduled for May 14-15, 1969; held Oct 8-9, 1969, National Research Council of Canada, Sub-Committee on Hydrology, p 59-80, Vol 1, 1969. 22 p, 1 tab, 8 ref.

Descriptors: *Instrumentation, *Stream gages, *Surface waters, Discharge measurement, Flowmeters, Tracking techniques, Remote sensing, Telemetry, Gaging stations, Streamflow, Velocity, Water levels, Aerial photography, Data processing.
Identifiers: Surface water instrumentation, Canada.

Methods for the measuring, recording and calculating of water levels, current velocities, water depths, and flow volumes are described with special emphasis on the advantages and disadvantages inherent in each of the measurement techniques. Techniques discussed include bubbler systems, closed pressure systems, and float systems for water level recording; current meter measurements and dilution methods for flow measurements; and sounding equipment, weirs, flumes, spillways, and turbines. Some emphasis is placed on the effects of Canada's variable climate on instrumentation and measurement techniques. The use of indirect methods such as maximum gages and other types of partial record stations are examined. Recent and possible future developments such as leasing edge current meters, velocity measurements by aircraft (Russia) and the use of digital recorders and automatic plotters or chart readers as part of the automation of data processing are surveyed. Solutions for winter instrumentation and observation techniques are discussed. (Knapp-USGS)
W70-08615

AUTOMATIC HYDROLOGICAL DATA COLLECTING STATIONS,
Department of Energy, Mines and Resources, Ottawa (Ontario). Marine Sciences Branch.
For primary bibliographic entry see Field 07B.
W70-08620

PHOTOGRAPHIC REMOTE SENSING FOR HYDROLOGY,
Guelph Univ. (Ontario).
For primary bibliographic entry see Field 07C.
W70-08621

REMOTE SENSING BY INFRA-RED TECHNIQUES,
Department of Transport, Toronto (Ontario). Meteorological Branch.
For primary bibliographic entry see Field 07B.
W70-08623

TRACER TECHNIQUES IN HYDROLOGY,
Guelph Univ. (Ontario). Dept. of Soil Science.
For primary bibliographic entry see Field 07B.
W70-08624

FLOOD ROUTING USING A CONVECTIVE DIFFUSION MODEL,
Birmingham Univ. (England). Dept. of Civil Engineering.
I. E. Thomas, and P. R. Wormleaton.
Civil Engineering and Public Works Review, Vol 65, No 764, March 1970, p 257-259. 6 fig, 5 ref.

Descriptors: *Flood routing, *Streamflow, Hydrology, Hydraulics, *River systems, Design.
Identifiers: *Convective diffusion model, River Dee, North Wales.

An alternative routing procedure resulting from a recognition of the similarity of the flood wave profile to the transient concentration distribution curve for a mass of material diffusing in a stream flow was discussed. In its one dimensional form the convective diffusion model of the wave phenomenon was described. The usual methods for routing floods through open channels are the 'hydraulic' and 'hydrological' approach which was mentioned. The general research programme of the Water Resources Board on the regulation of the River Dee in North Wales provided an opportunity for testing the application of the diffusion routing method to a real river system. The general river configuration between Glyndyfrowy and Erbistock together with the positions of tributaries, gauging stations and sub-catchment boundaries were shown. Details of representative floods analyzed were given. Results of considering a flood sequence as a whole and routing the inflows using values of dispersion obtained by a simple averaging of the values for its component peaks were shown. (Kriss-Cornell)
W70-08848

A NOTE ON THE CELERITY OF WIND WAVES ON A WATER CURRENT,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Erich Plate, and Michael Trawle.
Journal of Geophysical Research, Vol 75, No 18, p 3537-3544, June 20, 1970. 5 fig, 3 tab, 11 ref. Grant GK-2142 (NSF) and Grant AT911-L)-1813 AEC.

Descriptors: *Waves (Water), *Winds, *Currents (Water), *Hydraulic models, Laboratory tests, Model studies, Wind velocity, Flumes.
Identifiers: Wind tunnel tests.

Measurements were made of water surface velocities and phase speeds of the dominant waves in fields of gravity waves at the interface between parallel streams of air and water moving either in the same or in opposite directions. Velocities in the air flow were correlated with those in the water current. The phase velocity depends on the water surface velocity, and it is concluded that the Airy wave theory gives values which are too low. An attempt is made to explain the results in terms of Biesel's model for wave motion on moving water with a linear velocity gradient. (Knapp-USGS)
W70-08936

A THREE COMPONENT DRAG PROBE FOR THE MEASUREMENT OF TURBULENT WATER VELOCITY FLUCTUATIONS,
Oregon State Univ., Corvallis. Dept. of Oceanography.
For primary bibliographic entry see Field 07B.
W70-08938

INTERCHANGE OF WATER BETWEEN THE MAJOR OCEANS,
Lamong-Doherty Geological Observatory, Palisades, N.Y.
Wallace S. Broecker, and Yuan-Hui Li.
Journal of Geophysical Research, Vol 75, No 18, p 3545-3552, June 20, 1970. 5 fig, 1 tab, 23 ref. Contract No AT (30-1)2663 AEC.

Descriptors: *Ocean circulation, *Water chemistry, *Tracking techniques, Stable isotopes, Oceans, Radioisotopes, Water circulation, Ocean currents, Currents (Water), Oceanography, Water temperature, Calcium carbonate, Chemical precipitation, Sedimentation rates.
Identifiers: Ocean water interchange.

A three-box model is used to evaluate the rate of exchange of water between the three major water types in the ocean: warm surface water, North Atlantic deep water, and Pacific and Indian deep water. The eight unknown fluxes (six for water and two for particles) are determined from material balance considerations for H2O, C-14, and total CO2 and from the requirement that the relationships between 0-18 and salinity observed in the ocean are not to be violated. The validity of the model is checked by comparing the predicted and observed rates of CaCO3 accumulation in deep-sea sediments. (Knapp-USGS)
W70-08939

WATER INVENTORY STUDIES IN THE UNITED STATES AND THE I.H.D. PROGRAM,
National Committee for the International Hydrological Decade, Washington, D.C.
L. A. Heindl.
In: Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association, Urbana, Illinois, p 299-302, 1969.

Descriptors: *Surveys, *Water resources, *United States, *International Hydrological Decade, Groundwater, Surface waters, Water resources development, Water supply, Water balance, Hydrology, Hydrography, Mapping, Data collections, Hydrologic data.
Identifiers: *National Water Atlas (US).

Water inventories in the United States are made largely on the basis of data compiled from federal networks of climatological, surface-water, groundwater, sediment-discharge, and chemical quality stations. These data are supplemented by data from state and special-purpose networks, including those of experimental and representative basins, snow courses, glacial and lysimeter stations, and lake-level gages. Water inventory studies usually are in the forms of water budgets or water balances. A proposal to present the principal elements of the hydrological regimen on uniform time and space scales for the 17 major basins of the conterminous United States and for all of the United States and its territories--a national water atlas--is now being reviewed. Large masses of data have been collected in the United States, but they have never been compiled in a unified way. The national water atlas is a proposal to compile these data so as to make them available for scientific analysis, education, planning of future studies, and the management of water resources as an integral part of our natural environment. (See also W70-08597)
W70-09001

CANADIAN RESEARCH,
National Committee for the International Hydrological Decade, Ottawa (Ontario).
Ira C. Brown.
In: Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association, Urbana, Illinois, p 303-307, 1969.

Descriptors: *Surveys, *Water resources, *International Hydrological Decade, Groundwater, Surface waters, Water resources development, Water supply, Water balance, Hydrology, Hydrography, Mapping, Data collections, Hydrologic data, Glaciers.
Identifiers: *Canada, *National Hydrological Atlas (Canada).

Canada's International Hydrological Decade program of 211 projects includes most of the research effort relating to water balance. Nearly all projects are cooperative with from 3 to 14 participating agencies. In 1968 the program represented a total investment of $4.75 million with universites coordinating 61 projects, provincial agencies 65 and federal agencies 85. The organization to promote and coordinate this program is described, together with the method of funding and the programs for exchange of information and education. Inventories of glaciers and lakes are well under way and the Hydrological Atlas of Canada is in preparation. International cooperative efforts involve coordination with the United States of Decade stations along our border, inclusion of 7 glacier basins in worldwide chains, and the Canadian/United States International Field Year on the Great Lakes program, an intensive 18-month study of Lake Ontario. (See also W70-08597)
W70-09002

FLOOD OF APRIL 1968 AT MANY, LOUISIANA,
Geological Survey, Washington, D.C.
Alfred S. Lowe.
For sale by U S Geological Survey, Wash, D C 20402 - Price $0.50. U S Geological Survey Hydrologic Investigations Atlas HA-374, 1 sheet, 1970. Text, 7 fig, 1 map, 3 tab, 4 ref.

Descriptors: *Floods, *Louisiana, *Cloudbursts, Profiles, Maps, Mapping, Frequency analysis, Rainfall-runoff relationships, Stage-discharge relations, Discharge (Water), Storm runoff, Historic flood, Peak discharge.
Identifiers: Many (La).

On April 8-9, 1968, an almost stationary line of thunderstorms from 50 to 75 miles wide produced torrential rains in the northern half of Louisiana. The greatest rainfall of the storm, 12.48 inches, fell in the Many area and caused flooding in and around Many. The approximate area of inundation caused by the four streams that surround Many--Harpoon Bayou, Phillips Creek, Blackwell Creek, and San Jose Creek--is shown on a photomosaic map. Most of the flooded area was under water for less than 24 hours. This report presents hydrologic data that can be used to evaluate the extent and frequency of flooding that affect the economic development of flood plains in the Many area. It will aid individuals, government agencies, and others responsible for solving existing flood problems. The report will also be useful for preparing building and zoning regulations, locating waste disposal facilities, and developing recreational areas. (Knapp-USGS)
W70-09008

2F. Groundwater

LOCAL VARIATIONS IN THE WATER BALANCE: GEOLOGIC FACTORS,
University of Western Ontario, London. Dept. of Geology.
For primary bibliographic entry see Field 02D.
W70-08605

NEW TECHNIQUES IN THE SEARCH FOR WATER IN LIMESTONE,
Auburn Univ., Alabama. Water Resources Research Inst.; and Alabama State Geological Survey, University.
James C. Warman, Philip E. LaMoreaux, and Thomas J. Joiner.
Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association publication, Urbana, Illinois, p 144-146, 1969. 3 p

Descriptors: *Surveys, *Hydrogeology, *Limestones, *Carbonate rocks, *Alabama, Karst, Aquifers, Groundwater, Groundwater movement, Hydrologic budget, Recharge, Discharge (Water), Water supply, Hydrologic data, Data collections, Water levels, Water yield.
Identifiers: Limestone aquifers.

In research on the hydrology of the limestone terrane in north Alabama geological, geophysical, and geochemical techniques are used. In addition to more conventional methods, newer methods such as aerial photography are used to help define the lithologic and structural character of the rocks and the hydrologic system. Comprehensive evaluation enhances the probability of determining favorable areas for development of groundwater. Wells drilled in areas deemed favorable on the basis of techniques applied in this research are significantly more productive than wells drilled in other areas. (Knapp-USGS)
W70-08609

DECODING AERIAL PHOTOGRAPHS OF GLACIAL LANDSCAPES - INDICATORS OF GROUNDWATERS,
For primary bibliographic entry see Field 07B.
W70-08610

INSTRUMENTATION AND OBSERVATION TECHNIQUES.
For primary bibliographic entry see Field 07B.
W70-08611

GROUNDWATER INSTRUMENTATION AND OBSERVATION TECHNIQUES,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
J. A. Gilliland.
Proceedings of Canadian Hydrology Symposium No 7, Victoria, British Columbia, scheduled for May 14-15, 1969; held Oct 8-9, National Research of Canada, Subcommittee on Hydrology, p 37-57, Vol 1, 1969. 21 p, 10 fig, 22 ref.

Descriptors: *Instrumentation, *Groundwater, *Hydrogeology, *Groundwater movement, *Aquifers, Sampling, Telemetry, Observation wells, Geophysics, Borehole geophysics, Radioactivity techniques, Tracers, Tracking techniques, Piezometers, Piezometry, Seismic studies, Electrical studies, Data processing, Data storage and retrieval, Data transmission.
Identifiers: Groundwater instrumentation, Canada.

Rapid changes in the sophistication of groundwater measuring techniques have taken place during the past five years. A brief review presents the standard measuring techniques in groundwater hydrology followed by an extensive survey of more modern techniques. Groundwater flow measurement may be made by observation wells. The equipment and techniques for such measurement include installation of piezometers and the use of pressure tranducers. Observation wells can be used as seismometers to yield aquifer parameters. Geophysical techniques are applied to groundwater studies. They include electrical and radioactive methods of borehole logging, along with surface methods of geophysical surveying for aquifers, including seismic, gravity, resistivity, and electromagnetic methods. Equipment digitization methods for data storage and transmission include telemetering and remote collection of data and use of computers in

data processing. Techniques and equipment for sampling the quality of groundwaters and determination of fluid potentials include packers and sampling devices. (Knapp-USGS)
W70-08614

REMOTE SENSING GEOPHYSICAL APPLICATIONS TO HYDROLOGY,
Geological Survey of Canada, Electrical Methods Section.
L. S. Collett.
Proceedings of Canadian Hydrology Symposium No 7, Victoria, British Columbia, scheduled for May 14-15, 1969; held Oct 8-9, 1969, National Research Council of Canada, Subcommittee on Hydrology, p 237-260, Vol 1, 1969. 24 p, 12 fig, 1 tab, 18 ref.

Descriptors: *Remote sensing, *Hydrogeology, *Aquifers, *Groundwater, Saline water intrusion, Geophysics, Electrical studies, Magnetic studies, Subsurface mapping.
Identifiers: Canada, Airborne geophysical surveys.

The presence of groundwater is related to geology and geological structures, which can nearly always be characterized locally by the electrical parameters of conductivity and dielectric constant. Conductivity exhibits by far the largest variations of its magnitude for various rock materials. Structures which contain fresh water will always exhibit a fairly low conductivity. Through the mapping of these properties by remote sensing geophysical techniques can be applied to hydrology. Where the host structures are shallow, airborne VLF (Very Low Frequency) systems look promising for detecting variations in ground conductivity. For the deeper case where faulting and shear zones contain water in the fractures, audio frequency magnetics is presently being applied. A conventional airborne EM system is used for resistivity mapping of geological structure and salt-water intrusions. (Knapp-USGS)
W70-08619

TRACER TECHNIQUES IN HYDROLOGY,
Guelph Univ. (Ontario). Dept. of Soil Science.
For primary bibliographic entry see Field 07B.
W70-08624

HUEY V STATE (NO RIGHT TO DAMAGES FOR DIVERSION OF UNDERGROUND WATER SUPPLY).
For primary bibliographic entry see Field 06E.
W70-08790

INFILTRATION RATES IN SOILS OF THE EDMONTON AREA AND RAINFALL INTENSITIES,
Alberta Univ., Edmonton. Dept. of Soil Science.
For primary bibliographic entry see Field 02G.
W70-08819

GROUNDWATER FLOW SYSTEMS AND ACCUMULATION OF EVAPORITE MINERALS,
Idaho Univ., Moscow. Coll. of Mines.
Roy E. Williams.
American Association of Petroleum Geologists Bulletin, Vol 54, No 7, p 1290-1295, July 1970. 2 fig, 30 ref.

Descriptors: *Reviews, *Bibliographies, *Groundwater movement, *Geochemistry, *Chemical precipitation, Water quality, Groundwater basins, Water circulation, Permeability, Sedimentary rocks, Flow, Evaporation, Convection, Porous media, Discharge (Water), Recharge, Solutes, Aqueous solutions.
Identifiers: Evaporite deposits.

The literature on evaporite mineral deposits suggests a functional relation between the origin of these deposits and groundwater flow systems. Comparison of reported spacial variations of groundwater quality with pertinent solutions to flow equations under specified boundary conditions reveals that quality of groundwater is a function of flow-path length, flow-path route and flow velocity. Selected references provide evidence that sites of accumulation of nonmarine evaporite minerals are discharge zones for poor-quality water from regional or intermediate groundwater flow systems. Reported isotope ratios in oil field brines and standard mean ocean water indicate that water in some deep brines is of meteoric origin; therefore, such brines must be part of a groundwater flow system. Similarly, fluid potential values in the saline parts of certain groundwater flow systems along the Atlantic Coast of the United States reveal that saline groundwater in such systems discharges toward the ocean floor. Therefore, groundwater flow systems act as transport agents for dissolved solids which under appropriate geomorphic and climatic conditions, are contributed to marine evaporite deposits. (Knapp-USGS)
W70-08935

LAND-SURFACE TILTING NEAR WHEELER RIDGE, SOUTHERN SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 08E.
W70-08953

STORAGE AND HYDROLOGIC PROCESSES,
Saskatchewan Univ., Saskatoon. Div. of Hydrology.
For primary bibliographic entry see Field 02A.
W70-08987

WATER INVENTORY STUDIES IN THE UNITED STATES AND THE I.H.D. PROGRAM,
National Committee for the International Hydrological Decade, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-09001

CANADIAN RESEARCH,
National Committee for the International Hydrological Decade, Ottawa (Ontario).
For primary bibliographic entry see Field 02E.
W70-09002

2G. Water in Soils

FACTORS AFFECTING PERCOLATION IN A FOREST SOIL,
Washington Univ., Seattle. Coll. of Forest Resources.
Dale W. Cole, and Peter S. Machno.
Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association publication, Urbana, Illinois, p 101-109, 1969. 9 p, 2 tab, 18 ref.

Descriptors: *Water balance, *Infiltration, *Soil water movement, *Forests, Model studies, Mathematical models, Hydrograph analysis, Base flow, Consumptive use, Evapotranspiration, Water yield improvement, Forest management, Water storage, Soil water.
Identifiers: Soil water storage.

Specific factors affecting the water balance in a forest ecosystem are examined both theoretically and through actual field measurements. The variety of techniques that have been devised to evaluate soil water flow and retention are evaluated in regards to sensitivity and applicability. These techniques include theoretical models utilizing mathematical approaches and field techniques where measurements of soil moisture amounts and rates of flow are directly assessed. Specific examples illustrating the effects of horizontal layering, prior soil moisture conditions and pore distribution on soil water flow are cited. Sources of variability in the hydrograph characteristics of flow are examined using data from field measurements. For example, changes in flow rates as a function of depth and water use by plants are presented. Data illustrating changes in flow characteristics and total water yield following the removal of the forest canopy are also discussed. (Knapp-USGS)
W70-08603

SOIL MOISTURE,
Department of Agriculture, Ottawa (Ontario). Soil Research Inst.
G. C. Topp.
Proceedings of Canadian Hydrology Symposium No 7, Victoria, British Columbia, scheduled for May 14-15, 1969, held Oct 8-9; 1969, National Research Council of Canada, Subcommittee on Hydrology, p 21-36, Vol 1, 1969. 16 p, 47 ref.

Descriptors: *Instrumentation, *Soil water movement, Mass transfer, Nuclear moisture meters, Soil water, Soil moisture meters, Nuclear magnetic resonance, Flowmeters, Unsaturated flow.
Identifiers: Soil water flowmeters, Canada.

Recent advances or other techniques in soil-water measurement are discussed. Water content is a function of the pressure. A transfer of water depends on the pressure gradients in the soil. Tensiometric, vapor pressure and other methods of measuring water pressure or potential are described and evaluated with regard to laboratory and field studies. Water content determinations are improved by recent modifications in techniques involving neutron moderation and gamma ray attenuation. For small samples, nuclear magnetic resonance gives a reliable measure of water content. Two new methods make use of the water content dependent propagation of ultrasonic waves and the water content dependent 'fringe' capacitance. Two flowmeters for in situ flow rates are described and suggested for use in hydraulic conductivity determinations. (Knapp-USGS)
W70-08613

INVERSE FORMULATION AND FINITE DIFFERENCE SOLUTION TO PARTIALLY SATURATED SEEPAGE FROM CANALS,
Utah State Univ., Logan; and Computer Sciences Corp., Richland, Wash.
Roland W. Jeppson, and R. William Nelson.
Soil Science Society of America Proceedings, Vol 34, No 1, p 9-14, Jan-Feb 1970. 6 p, 2 fig, 12 ref.

Descriptors: *Unsaturated flow, *Seepage, *Canal seepage, Formulation, Steady flow, *Finite differences, Theory, Porous media, *Flow nets, Soil water movement, Equations, Mathematical analysis, Hydraulic conductivity.
Identifiers: Finite difference method, Computer applications, Porous media flow.

The mathematical model describing Darcian flow of water through soils approximates actual occurrences more closely when regions of the flow are permitted to be partially saturated. A generally accepted relationship between effective permeability and capillary pressure is utilized to formulate and solve by inverse methods with finite differences the steady-state flow system of water through soils. The inverse formulation considers the cartesian coordinates x and y as the dependent variables, and the potential function, phi, and the 2-dimensional stream function, psi, as the independent variables (the problem is solved for x and y in the phi-psi plane). The form of the solutions obtained from the inverse procedure is ideally adapted for plotting flow nets and obtaining other quantities such as hydraulic gradients, pressures, velocities, and relationships between capillary tension and moisture content anywhere within the flow field. A flow net for partially saturated seepage from a canal was obtained using the method and an electronic computer for the computations. (USBR)
W70-08679

INFILTRATION RATES IN SOILS OF THE EDMONTON AREA AND RAINFALL INTENSITIES,
Alberta Univ., Edmonton. Dept. of Soil Science.
T. R. Verma, and J. A. Toogood.
Canadian Journal of Soil Science, Vol 49, No 1, p 103-109, February 1969. 3 fig, 3 tab, 9 ref.

Descriptors: *Infiltration, *Soil types, *Rainfall intensity, *Vegetation effects, *Soil management, Runoff, Runoff forecasting, Impervious soils, Rainfall, Air-earth interfaces, Precipitation (Atmospheric), Erosion, Erosion control, Soil water, Groundwater, Semiarid climates.
Identifiers: *Infiltration rates, *Alberta (Canada), Edmonton sheet.

The major soil types in the vicinity of Edmonton, Alberta (Canada) were studied in order to determine their infiltration rates. Soils ranged from undisturbed to recently cultivated, from impervious to open and well-drained. Types of ground cover included fallow, grass, mixed forage, and grain. When rainfall intensity in the area was related to infiltration rates, it appeared that there was little likelihood of runoff from soils of the Edmonton sheet. On the Solonetzic soils, however, runoff might occur, although even this tendency would be counteracted by high initial infiltration rates. The total picture indicated a very slight runoff hazard during summer storms near Edmonton. Good soil management should properly protect local soils from water erosion during summer storms, although special problems might arise during spring runoff when the ground is frozen. (Carr - Arizona)
W70-08819

STORAGE AND HYDROLOGIC PROCESSES,
Saskatchewan Univ., Saskatoon. Div. of Hydrology.
For primary bibliographic entry see Field 02A.
W70-08987

2H. Lakes

FACTORS INFLUENCING PHOSPHATE USE BY ALGAE,
Minnesota Univ., Minneapolis. Limnological Research Center.
For primary bibliographic entry see Field 05C.
W70-08637

PHOSPHATES IN PEORIA LAKE: A QUANTITATIVE AND QUALITATIVE EVALUATION OF A NUTRIENT IN NATURAL WATERS,
Illinois State Water Survey, Peoria. Water Quality Section.
William T. Sullivan, and David L. Hullinger.
Transactions of the Illinois State Academy of Science, Vol 62, No 2, p 198-217, 1969. 5 fig, 14 tab, 33 ref.

Descriptors: *Phosphates, *Illinois, *Nutrients, Industrial wastes, Municipa' wastes, Agriculture, Runoff, Flow, Seasonal, Chemical analysis, Biological properties, Sampling, Load distribution.
Identifiers: *Peoria Lake (Ill), Illinois River, Orthophosphate, Polyphosphate, Organic phosphate.

Peoria Lake is situated midway between Chicago and the Mississippi River on the Illinois Waterway; its waters are substantially augmented by a variety of soluble and suspended materials from municipal and industrial wastes and from agricultural watersheds. A study of the chemical and biological characteristics of Peoria Lake was conducted during March-October 1967. Samples were collected on 25 dates from 9 stations at a standard 3-feet depth. Laboratory analysis of soluble and particulate fractions of ortho-, poly-, and organic phosphate forms has allowed evaluation of the various phosphates found in these natural waters. The phosphorus budget for the study period showed the mean daily phosphate load for all fractions and forms entering the lake to be 77,200 pounds; total phosphate leaving the lake was 63,400 pounds. The net phosphate apparently retained in Peoria Lake was calculated to be a mean of 13,800 pounds/day, or 17.9% of the influx. Possible mechanisms affecting this retention and distribution of the various fractions and forms are discussed. Although nutrient conditions appeared sufficient to support plankton populations, they were non-existent. (Jones-Wisconsin)
W70-08653

RELATIONSHIPS BETWEEN BACTERIA AND PHYTOPLANKTON,
Byelorussian State Univ., Minsk (USSR). Dept. of Invertebrate Zoology.
Yu S Potaenko, and T M Mikheeva.
Trans. from Mikrobiologiya, Vol 38, No 4, p 722-727. July-Aug 1969. Microbiology, Vol 38, No 4, p 603-607, 1969. 3 fig, 37 ref.

Descriptors: *Bacteria, *Phytoplankton, *Lakes, Algae, Microorganisms, Biomass, Diatoms, Cyanophyta, Iron, Algicides, Zooplankton, Fish.
Identifiers: Byelorussia (USSR), Polychloropinene.

Several factors may be operational simultaneously in the characteristics of the relationship between bacteria and phytoplankton. Study of bacterioplankton and phytoplankton of eight Byelorussian lakes in different years showed there were extremely diverse relationships between algae and other microorganisma: growth of algae and bacteria proceeded in parallel, maximum algal development corresponded to minimum bacterial population and vice versa, or the growth of these groups of organisms was independent. No definite relationship was observed between bacterial growth and the presence of a given toxonomic algal group. The usual cycles for individual species and algal groups were reestablished when the disrupted equilibrium among different elements of the food chains was restored a year after the fish kill. From a study of variation in bacterioplankton grown in the Narochanskii Lakes and from data in the literature of the seasonal dynamics of bacterial population in a number of other lakes, it can be concluded that the bacterioplankton distribution and population characteristic of other eutrophic lakes in the Soviet Union is restored within 1.5 years after treatment with PCP compound. (Jones-Wisconsin)
W70-08654

NEAR-SHORE WATER CHEMISTRY OF EASTERN LAKE ERIE,
State Univ. Coll., Fredonia, N.Y.
George W. Schmidt.
Lake Erie Environmental Studies, Technical Data Report No 2. 34 p, 13 fig, 2 tab, 8 ref.

Descriptors: *Lake Erie, *Water chemistry, Physical properties, Temperature, Seasonal, Dissolved oxygen, Biochemical oxygen demand, Hydrogen ion concentration, Carbon dioxide, Runoff, Hardness (Water), Alkalinity, Detergents, Lignins, Winds, Tributaries, Waves (Water), Oxidation-reduction potential, Iron, Ammonia, Silica, Suspended load, Phosphates, Coliforms, Bicarbonates, Chlorides, Sulfates, Nitrates, Copper, Trace elements, Precipitation (Atmospheric), Magnesium, Turbidity.
Identifiers: *Near-shore, *Eastern Lake Erie, Tannins, Chromates, Conductance.

A base line of physical and chemical parameters for near-shore waters of the eastern basin of Lake Erie has been established for an 18 month period from mid-July 1968 through mid-December 1969. Variations due to water temperature changes were detectable in dissolved oxygen concentration, biochemical oxygen demand, and hydrogen ion concentration. Dissolved carbon dioxide concentration was not shown to be water temperature dependent by the method employed. Hydrogen ion concentration data do indicate that solubility of carbon dioxide was probably dependent on water temperature. Effluents of individual streams were detectable in the water chemistry of the lake, which varied widely in chemical constituents on both seasonal and random basis. Mixing of near-shore waters was generally dependent upon wind velocities and wave conditions. Calm periods, in which little mixing occurred, appeared to have caused a stanc ing water mass along the near-shore area. Thi might have influenced decomposing organic matte to decrease the oxidation-reduction potential lo cally. Continuous recording devices to monito water temperature, dissolved oxygen concentra tion, hydrogen ion concentration, specific con ductance, oxidation-reduction potential, wate level, and local stream discharge would be of tre mendous value in interpreting short term change in all parameters. (Jones-Wisconsin)
W70-08658

BIOLOGICAL EFFECTS ON SEDIMENT-WATER NUTRIENT INTERCHANGE,
California Univ., Berkeley. Sanitary Engineering Research Lab; and Sunn, Low, Tom, and Hara, Inc., Honolulu, Hawaii.
For primary bibliographic entry see Field 05C.
W70-08944

2I. Water in Plants

CHEMICAL PROPERTIES, PHYSICAL PROPERTIES AND PLANT GROWTH IN TWENTY ARTIFICIAL WILDLIFE MARSHES,
Cornell Univ., Ithaca, N. Y. Dept. of Agronomy.
D. J. Lathwell, H. F. Mulligan, and D. R. Bouldin.
New York Fish and Game Journal, Vol 16, No 2, p 158-183, July 1969. 26 p, 2 fig, 17 tab, 8 ref.

Descriptors: *Water chemistry, *Marshes, *Marsh management, *Habitat improvement, *Soil-water-plant relationships, Flooding, Wildlife management, Soil chemistry, Marsh plants, Swamps, Water balance, Energy budget, Nutrients.
Identifiers: Artificial Wildlife marshes.

Measurements of physical and chemical characteristics of water and bottom soil were made throughout each season from 1960 to 1967 on 20 artificial marshes to determine factors that influenced the growth of aquatic plants important as food sources for wildlife. Water depth was varied from 1 to 3 feet, and throughout the study greater plant growth was observed in the shallower marshes. Additions of organic matter to the bottom soils resulted in increased plant growth early in the study, but in later years they had little effect. The additions of limestone to this neutral to calcareous soil material had no effect on plant growth. Of the factors measured, to extractable iron in the sediment increased at an increasing rate while extractable manganese increased only slightly over the course of the study. Total alkalinity of the water decreased consistently throughout the first six years, but it increased during the last two years of the study. (Knapp-USGS)
W70-08595

HOW CROPS ABSORB WATER,
Duke Univ., Durham, N. C. Dept. of Botany.
Paul J. Kramer.
Connecticut Agricultural Station, New Haven, Bulletin 708, p 42-62, July 1969. 9 fig, 3 tab, 55 ref.

Descriptors: *Soil-water-plant relationships, *Root systems, *Flow resistance, *Chemical potential, *Absorption, *Soil water movement, Salt tolerance, Aeration, Soil temperature, Transpiration, Hydraulic conductivity, Xylem, Dehydration, Arid lands, Breeding, Turgidity, Leaves, Stomata, Soil texture, Osmotic pressure, Dessicants, Cuticle.
Identifiers: *Water feedback loops, *Root surface area, *Salinity tolerance, *Water potential, *Dehydration tolerance, Active transport, Passive transport, Suberized roots, Root hairs, Root hormones, Guttation.

Available data indicates that crop plants use 250-500 units of water per unit of dry matter produced. Continued growth therefore depends on a balance between absorption gains and transpiration losses. Plant water absorption is directly related to water potential differences between soil and root surface or between root surface and root xylem. The physical factors affecting root water absorption are discussed and it is argued that not only are water and salts absorbed by root hairs but also by suberized roots. Roots also produce chemical substances which indirectly affect plant water balance. Soil water availability and absorption are functions of soil water potential, soil hydraulic conductivity, soil temperature, soil aeration, soil salinity and root water potential. The importance of each limiting factor is discussed particularly for semi-arid and arid zone soils. The major factors in any program of breeding for improved plant water balance mechanisms would be: (1) Improved root systems (2) Transpiration reduction (3) Increased dehydration tolerance (4) Increased salt tolerance. (Casey - Arizona)
W70-08816

ENVIRONMENTAL FACTORS AFFECTING RESISTANCE TO DESICCATION IN THE DIATOM STAURONEIS ANCEPS,
Arizona Univ., Tuscon. Dept. of Biological Sciences.
H. P. Hostetter, and R. W. Hoshaw.
American Journal of Botany, Vol 57, No 5, p 512-518, May-June 1970. 6 fig, 4 tab, 14 ref.

Descriptors: *Diatoms, *Dehydration, *Drought resistance, *Environmental effects, *Moisture stress, Drying, Drought, Algae, Aquatic algae, Arid lands, Deserts, Arizona, Particle size, Temperature, Cultures, Cytological studies, Plant physiology.
Identifiers: *Survival, *Metabolites.

Among the environmental parameters affecting the ability of Stauroneis anceps Ehr. to withstand conditions of severe water stress are culture age, type of medium, temperature, vapor pressure, and particle size of substrate. Cells grown in soil-water survived drying to equilibrium with atmospheric humidity better than cells grown in defined medium. Similarly, cells grown from older cultures survived better than those from young ones, perhaps due to accumulation by older cultures of secreted metabolites in the medium. If drying occurs in artificial substrata there is survival when particulate matter is 100 microns in diameter or larger, but no survival at less than 50 microns. Slow drying apparently enhances survival and desiccated cells withstand temperature extremes better than vegetative cells in an aqueous environment. Normal cultures could not survive 1 hr at 60 C, but dry cells survived more than 9 days at that temperature and longer than 8 hr at 80 C. Vapor pressure deficits of 11.9 mm Hg or higher facilitated cell survival under storage. Since algal cells are able to withstand long periods of dehydration and this desiccated state enables them to survive extremely high temperatures, it would appear that survival of algae in ephemeral desert pools often involves dehydrated cells. (Carr - Arizona)
W70-08817

GROWTH, YIELD, AND YIELD COMPONENTS OF SAFFLOWER AS AFFECTED BY IRRIGATION REGIMES,
Arizona Agricultural Experiment Station, Tucson.
Leonard J. Erie, and Orrin F. French.
Agronomy Journal, Vol 61, No 1, p 111-113, January-February 1969. 1 fig, 5 tab, 1 ref.

Descriptors: *Arizona, *Oilseed crops, *Crop production, *Plant growth, *Water requirements, Soil water, Irrigation, Irrigation effects, Irrigation practices, Crop response, Arid lands, Soil moisture, Moisture availability, Moisture stress, Consumptive use, Soil-water-plant relationships, Flowering, Seeds.
Identifiers: *Safflower, *Irrigated agriculture, *Yield components.

Safflower (Carthamus tinctorius L.) was grown in Arizona in order to study the effect of irrigation regime on plant growth and seed yield. Fall-planted Frio safflower was subjected to 8 different irrigation treatments. Four treatments were irrigated when 60% of the available moisture in the upper 120 cm of soil was depleted; four other treatments were irrigated at the 72% level. Five irrigation cutoff dates were used, varying from 3 weeks before first flowering until harvest. Individual plots received from 3 to 9 irrigations, depending on the combination of soil moisture depletion treatments and varying cutoff dates. The study found that with each increment of irrigation water there was a tendency for seed yield, weight per seed, seeds per head, and oil content to increase, while percentage of hollow seed decreased. It would appear that 7 irrigations given until the last flowers opened was the preferable irrigation regime. The treatment yielded 3,961 kg/ha of seed and consumed 107 cm of water. This resulted in the greatest seed yield per centimeter of water used by the plant. When last irrigation occurred at the time of first flowering, yield declined 800 kg/ha. Last irrigation 10 days prior to flowering caused a reduction in yield of almost one-half. (Carr - Arizona)
W70-08818

WATER UPTAKE BY ORCHARDGRASS AND EVAPORATION FROM BARE SOIL IN THE PRESENCE OF SHALLOW WATER TABLES,
Department of Agriculture, Lethbridge (Alberta). Research Station.
For primary bibliographic entry see Field 02D.
W70-08820

EFFECT OF THE SOL-GEL TRANSFORMATION IN CLAY-WATER SYSTEMS ON BIOLOGICAL ACTIVITY: I. SEED GERMINATION AND BACTERIAL THERMOGENESIS,
Purdue Univ., Lafayette, Ind. Dept. of Agronomy.
For primary bibliographic entry see Field 02K.
W70-08952

VEGETATION MANAGEMENT FOR WATER YIELD,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 03B.
W70-08991

2J. Erosion and Sedimentation

PRELIMINARY STUDY OF TRANSVERSE BARS,
Florida State Univ., Tallahassee. Geophysical Fluid Dynamics Inst.
For primary bibliographic entry see Field 02L.
W70-08590

BRYOZOAN CARBONATE SAND CONTINUOUS ALONG SOUTHERN AUSTRALIA,
Sydney Univ. (Australia). Dept. of Geology and Geophysics; South Carolina Univ., Columbia. Dept. of Geology; and New South Wales Univ., Kensington (Australia). Dept. of Zoology.
Robin E. Wass, John R. Conolly, and R. J. Macintyre.
Marine Geology, Vol 9, No 1, p 63-73, June 1970. 11 p, 6 fig, 3 tab, 13 ref.

Descriptors: *Sands, *Calcium carbonate, *Bottom sediments, *Benthic fauna, Marine animals, Sands, Sedimentary structures, Sampling, Data collections.
Identifiers: *Australia, Bryozoa.

Modern and reworked Pleistocene and Tertiary bryozoan calcareous sand extends over the 20-150 miles wide and 2,500 miles long continental shelf of southern Australia from north of Perth on the west coast, eastwards to east Bass Strait. Bottom photography and dredge samples reveal that living Bryozoa thrive most abundantly at depths of 50-120 fathoms and that catenicelliform Zoaria occur in fine grained sand in quite water whereas lunulitiform Zoaria live in loose, moving, rippled sands; reteporiform Zoaria are common in water with mild current action. Adeoniform and vinculariiform Zoaria commonly occur at depths greater than 100 fathoms. (Knapp-USGS)
W70-08591

SAND RIBBONS OF EUROPEAN TIDAL SEAS,
National Inst. of Oceanography, Wormley (England).
For primary bibliographic entry see Field 02L.
W70-08592

SEDIMENTS OFF THE WEST COAST OF BARBADOS: DIVERSITY OF ORIGINS,
McGill Univ., Montreal (Quebec).
Ian G Macintyre.
Marine Geology, Vol 9, No 1, p 5-23, June 1970. 19 p, 8 fig, 34 ref.

Descriptors: *Bottom sediments, *Oceans, *Continental shelf, Marine geology, Carbonates, Sands, Carbonate rocks, Sedimentation, Provenance, Deposition (Sediments), Diagenesis.
Identifiers: *Barbados.

A multiplicity of sources is evident in marine sediments off the west coast of Barbados, W.I., where sediments and morphology of the sea floor studied to a depth of 1,300 ft. A high percentage of the carbonate material was not formed in the present environment of deposition. Shoreward of a depth of 70 ft., sediments of the insular shelf facies are composed mainly of modern skeletal material along with detrital deposits. Between depths of 70 and 400 ft. (an area that includes two submerged reefs) sediments of the upper slope facies contain a complicated mixture of relict residual, modern organic and volcanic material. Seaward of a depth of about 400 ft. in the slope facies, sediments are composed mainly of residual material derived from submarine outcropping beds, but include some volcanic and modern organic material. The pyroclastic material in the marine sediments was derived from La Soufriere on the island of St. Vincent, which is 100 miles west and leeward of Barbados. Then noncarbonate fraction of the insular shelf sands is predominantly detrital quartz. Grey discoloration in carbonate grains, which is caused primarily by the presence of diagenetic pyrite, occurs in those grains that were transported into stagnant, ponded river mouths that are common along the west coast of Barbados. (Knapp-USGS)
W70-08593

INSTRUMENTATION AND TECHNIQUES IN SEDIMENT SURVEYING,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
W. Stichling.
Proceedings of Canadian Hydrology Symposium No 7, Victoria, British Columbia, scheduled for May 14-15, 1969; held Oct 8-9, 1969, National Research Council of Canada, Subcommittee on Hydrology, p 81-139, Vol 1, 1969. 59 p, 42 fig, 26 ref.

Descriptors: *Instrumentation, *Sediment load, *Sampling, Data processing, On-site tests, Laboratory tests, Sediment discharge, Suspended load, Bed load, Surveys, Data collections.
Identifiers: Sediment instrumentation, Canada.

Satisfactory instruments and techniques for measuring suspended sediment discharge have been developed over the last 25 years and the use of radioisotope and other monitoring instruments promises to increase the effectiveness of existing methods. In the case of bed-load discharge measurement, however, equipment and techniques are still far from satisfactory. There is hope that research into the use of tracers or other techniques may lead to a breakthrough. The grain-size distribution in the bed material must be known and in-

formation on other hydraulic parameters must be available. Satisfactory sampling of bed material is possible using existing equipment. The field and laboratory equipment and techniques used in Canada for measuring suspended sediment discharge and bed-load discharge and for sampling bed material are described. (Knapp-USGS)
W70-08626

GRAIN ORIENTATION IN DETERMINATION OF PALEOCCURRENTS AND SANDSTONE TRENDS,
Oklahoma State Univ., Stillwater. Dept. of Geology.
John W. Shelton, and Douglas E. Mack.
American Association of Petroleum Geologists Bulletin, Vol 54, No 7, p 1108-1119, July 1970. 10 fig, 1 tab, 24 ref.

Descriptors: *Sedimentary rocks, *Currents (Water), *Deposition (Sediments), *Sedimentary structures, Instrumentation, Laboratory tests, Borehole geophysics, Sedimentology, Sandstones, Sands.
Identifiers: Paleoccurrent analysis, Particle orientation.

Measurement of grain orientation in relatively large samples by means of a dielectric anisotropy device is both rapid and reliable. It corresponds accurately to other paleoccurrent indicators, such as parting lineation, rib-and-furrow structures, sole marks, and cross-bedding. Because grains are imbricated upcurrent, current direction can be inferred accurately from analysis of grain orientation in the vertical plane paralleling the horizontal grain fabric. Dielectric anisotropy measurements of partly impregnated Cimarron River sand depict very well recent local current directions of the river. Because the horizontal component of grain orientation in horizontally bedded or cross-bedded sands statistically corresponds to current trend, remote measurement of grain orientation in a borehole could make possible the determination of sandstone trend from a single well. Adaptation of the dipmeter log offers an available tool for such a technique. (Knapp-USGS)
W70-08933

GEOLOGICAL SIGNIFICANCE OF COCCOLITHS IN FINE-GRAINED CARBONATE BANDS OF POSTGLACIAL BLACK SEA SEDIMENTS,
Geological Survey, La Jolla, Calif. Marine Geology Lab; Cities Service Oil Co., Okla; and Woods Hole Oceanographic Institution, Mass.
David Bukry, Stanley A. Kling, M. K. Horn, and Frank T. Manheim.
Nature, Vol 226, No 5241, p 156-158, April 11, 1970. 2 fig, 1 tab, 19 ref.

Descriptors: *Bottom sediments, *Carbonates, Limestone, Mud, Sediments, Sedimentary rocks.
Identifiers: *Black Sea, *Coccoliths.

Samples containing fine carbonate from cores obtained during the cruise of Atlantis II (Woods Hole Oceanographic Institute) to the Black Sea in April and May 1969 were examined by scanning electron micrographs and light microscopy. Holocene coccoliths are the overwhelmingly dominant constituents in the light bands, whereas Cretaceous and Eocene coccoliths are important components of the carbonate in the darker matrix. (Knapp-USGS)
W70-08934

2K. Chemical Processes

WATERS FOR WATERFLOODING SAN JOAQUIN VALLEY, CALIF, PETROLEUM RESERVOIRS,
Bureau of Mines, San Francisco, Calif. Petroleum Research Office.
G. L. Gates, and W. H. Caraway.
U S Bureau of Mines Report of Investigations 7401, June 1970. 18 p, 4 fig, 7 tab, 25 ref.

Descriptors: *Water quality, *Water chemistry, *Water sources, *California, *Secondary recovery (Oil), Flooding, Injection, Oil fields, Oil reservoirs, Sea water, Fresh water, Brines, Irrigation water, Saline water, Permeability.
Identifiers: San Joaquin Valley (Calif).

Five possible sources of water for waterflooding of petroleum reservoirs in the arid San Joaquin Valley of California were considered. Three of them (water produced with petroleum, water from a shallow saline aquifer, and waste irrigation water) were analyzed chemically; laboratory information for sea water was developed in a previous study. A series of laboratory tests made on the fifth source (fresh water) determined the solubility of calcium sulfate dihydrate in water. Laboratory analyses included: chemical analyses of water produced with petroleum and waste irrigation water; solubility of calcium sulfate dihydrate in water and brines; the effect of excess sulfate on the solubility of calcium sulfate in brines; the presence of sulfate-reducing bacteria; and the permeability of cores from a petroleum reservoir. Most of the waters and mixtures of waters are compatible with petroleum reservoir waters and are generally suitable for injection. Formation damage due to clay swelling will not be serious. The waters most likely to be available for injection are water produced with petroleum, water from shallow saline aquifers, and waste irrigation water. (Knapp-USGS)
W70-08587

DETERMINING THE DISSOLVED OXYGEN IN SMALL QUANTITIES OF WATER,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 05A.
W70-08594

CHEMICAL PROPERTIES, PHYSICAL PROPERTIES AND PLANT GROWTH IN TWENTY ARTIFICIAL WILDLIFE MARSHES,
Cornell Univ., Ithaca, N. Y. Dept. of Agronomy.
For primary bibliographic entry see Field 02I.
W70-08595

INSTRUMENTATION IN WATER QUALITY MONITORING AND SAMPLING,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 05A.
W70-08616

A WATER QUALITY MODEL OF CHLORIDES IN GREAT LAKES,
Manhattan Coll., Bronx, N.Y. Dept. of Civil Engineering.
Donald J. O'Connor, and John A. Mueller.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 96, No SA4, Paper 7470, p 955-975, August 1970. 14 fig, 6 tab, 23 ref, append.

Descriptors: *Water quality, *Great Lakes, *Chlorides, *Salt balance, *Mathematical models, Water balance, Streamflow, Hydrologic budget.
Identifiers: Water quality models.

The increase in the concentration of conservative substances in the Great Lakes is described by a simple time variable equation. The concentration of chlorides is related to the fresh water flow, the volumes of the lakes and the various sources--municipal, industrial, natural background and road deicing. The increase in concentration since 1900 is presented and projections are made of anticipated concentrations based on various assumptions of control. (Knapp-USGS)
W70-08931

GROUNDWATER FLOW SYSTEMS AND ACCUMULATION OF EVAPORITE MINERALS,
Idaho Univ., Moscow. Coll. of Mines.
For primary bibliographic entry see Field 02F.
W70-08935

CONTENT OF TRACE ELEMENTS IN PRECIPITATION,
Main Geophysical Observatory, Liningrad (USSR) and Institute of Experimental Meteorology, Obninsk (USSR).
For primary bibliographic entry see Field 02B.
W70-08940

MODEL FOR CAPTURE OF RADIOACTIVITY BY PRECIPITATION,
Institute of Experimental Meteorology, Obninsk (USSR).
For primary bibliographic entry see Field 02B.
W70-08941

STRONTIUM 90 FALLOUT DISTRIBUTION AT MIDDLE LATITUDES OF THE NORTHERN AND SOUTHERN HEMISPHERES AND ITS RELATION TO PRECIPITATION,
Institute of Experimental Meteorology, Obninsk (USSR). Hydrometeorological Service.
For primary bibliographic entry see Field 02B.
W70-08942

EFFECT OF THE SOL-GEL TRANSFORMATION IN CLAY-WATER SYSTEMS ON BIOLOGICAL ACTIVITY: I. SEED GERMINATION AND BACTERIAL THERMOGENESIS,
Purdue Univ., Lafayette, Ind. Dept. of Agronomy.
K. W. Lee, B. G. Davey, and P. F. Low.
Soil Science Society of America Proceedings, Vol 34, No 1, p 45-49, January-February 1970. 4 fig, 2 tab, 28 ref.

Descriptors: *Clays, *Gels, *Soil-water-plant relationships, Ion transport, Ion exchange, Viscosity, Water chemistry.
Identifiers: Clay-water systems.

Gels containing 4, 6, and 8% Na or Na/Al clay (Na-clay with hydrous aluminum oxide impurity) were extruded through a 20-gage hypodermic needle into petri dishes. Half of the petri dishes were tapped on the laboratory bench to disturb the gels within them. Lettuce seeds were planted on all the samples; the lettuce seeds germinated faster on the disturbed gels. In a second experiment, gels containing 4% Na or Na/Al clay were mixed with nutrient medium and inoculated with the bacterium Streptococcus faecalis. Then the inoculated gels were extruded through a 20-gage hypodermic needle into pairs of calorimetric cells. Before inserting the cells into the Calvert calorimeter, one member of each pair was tapped to disturb the gel. Bacterial heat production was greater in the disturbed gels than in the undisturbed ones. In a third experiment, Na or Na/Al clay sols and gels were mixed with nutrient medium, inoculated, and extruded into pairs of calorimetric cells, as before. This time, neither cell was tapped to disturb its contents, but the concentration of clay in one was different from that in the other. There was more heat production in the cells in which the clay concentration was lower and the clay-water system was a sol. Biological activity was usually smaller in a clay gel than in a clay sol. (Knapp-USGS)
W70-08952

THE APPLICATION OF PHASE SELECTIVE ALTERNATING CURRENT POLAROGRAPHY TO THE ANALYSIS OF HEAVY METALS IN WATER,
Georgia Inst. of Tech., Atlanta. Environmental Resources Center.
For primary bibliographic entry see Field 05A.
W70-08986

2L. Estuaries

PRELIMINARY STUDY OF TRANSVERSE BARS,
Florida State Univ., Tallahassee. Geophysical Fluid Dynamics Inst.
A. W. Niedoroda, and W. F. Tanner.
Marine Geology, Vol 9, No 1, p 41-62, June 1970. 22 p, 7 fig, 28 ref. ONR Contract N-00014-68-A-0159.

Descriptors: *Sand bars, *Sedimentary structures, *Beaches, *Sand waves, Sediment transport, Deposition (Sediments), Scour, Erosion, Currents (Water), Waves (Water).
Identifiers: Transverse bars, Beach structure.

Transverse bars (finger bars) are extremely common along sandy beaches in low-to-moderate wave energy regimes. They are typically oriented normal or nearly normal to the beach toe. Each transverse bar acts as a focusing lens for advancing waves, controlling wave refraction in such a way that: (1) the transverse bar is maintained; (2) sediment is transported along the long axis of the bar; and (3) a subtle but nevertheless effective circulation pattern is established, whereby water is transported seaward from the surf, without rip currents. In areas where transverse bars are numerous and well developed, the onshore or offshore transport of sand along the bar axes may be more important than littoral drift. Preliminary data indicate that current strength is a direct function of the depth of water over the bars and an exponential function of the initial wave height. (Knapp-USGS)
W70-08590

BRYOZOAN CARBONATE SAND CONTINUOUS ALONG SOUTHERN AUSTRALIA,
Sydney Univ. (Australia). Dept. of Geology and Geophysics; South Carolina Univ., Columbia. Dept. of Geology; and New South Wales Univ., Kensington (Australia). Dept. of Zoology.
For primary bibliographic entry see Field 02J.
W70-08591

SAND RIBBONS OF EUROPEAN TIDAL SEAS,
National Inst. of Oceanography, Wormley (England).
Neil H. Kenyon.
Marine Geology, Vol 9, No 1, p 25-39, June 1970. 15 p, 12 fig, 22 ref.

Descriptors: *Bottom sediments, *Tides, *Currents (Water), *Continental shelf, *Sands, *Tidal waters, Oceans, Sedimentary structures, Sand bars, Sand waves, Sediments, Sediment transport, Sedimentation.
Identifiers: Sand ribbons, Europe.

Ribbons of sediment, up to 15 km long and up to 200 m wide, extend parallel to the bed load transport paths of the tidal currents. The ribbons have been found by the side-scan Asdic method in most of those areas of the sea floor around the British Isles where tidal currents have maximum near surface velocities of 2 knots or more. The four types of ribbons, distinguished by their form, are related to tidal current velocity and supply of sand. Underwater photographs taken in a sand ribbon zone reveal bodies of shelly sand usually too thin to mask completely the underlying coarse material, but sometimes thick enough for the formation of small-scale bedforms including ripple marks and sand shadows. There is a variety of underlying coarse material and locally there are accumulations between the sand ribbons of the more durable shells that may be more readily preserved in ribbon form than the sand itself. (Knapp-USGS)
W70-08592

SEDIMENTS OFF THE WEST COAST OF BARBADOS: DIVERSITY OF ORIGINS,
McGill Univ., Montreal (Quebec).
For primary bibliographic entry see Field 02J.
W70-08593

STUDIES OF THE MARINE MICROORGANISMS UTILIZING INORGANIC NITROGEN COMPOUNDS--IV. ON THE LIBERATION RATES OF INORGANIC NITROGEN COMPOUNDS FROM BOTTOM MUDS TO SEA WATER (In Japanese),
Kyoto Univ. (Japan). Dept. of Fisheries.
Yoichi Yoshida, and Masao Kimata.
English summary. Bulletin of the Japanese Society of Scientific Fisheries, Vol 35, No 3, p 303-306, 1969. 3 fig, 1 tab, 7 ref.

Descriptors: *Mud, *Sea water, *Nitrogen, Inorganic compounds, Ammonia, Nitrites, On site tests, Cores, Laboratory tests, Aphotic zone.
Identifiers: *Sea bottom muds, Inorganic nitrogen, Nitrate nitrogen, Maizuru Bay (Japan), Disphotic zone, Euphotic zone.

Release of ammonia, nitrite, and nitrate nitrogen from bottom muds to sea water was studied by direct sampling and by simulation of conditions in a small 60 centimeter-wide equarium. Analyses of water above the bottom and of mud cores, conducted from January till September 1967, showed the liberation of elemental nitrogen from 0.1 to 2.0 microgram per 100 square centimeter/hour. The largest part of the released nitrogen was in ammonia form. The trials under laboratory conditions yielded similar results, even though the bottom mud in aquarium contained predominantly nitrate nitrogen. (Wilde-Wisconsin)
W70-08661

TIME AND EXTENT OF A FLOW REVERSAL IN THE LOWER COLUMBIA RIVER,
Bureau of Commercial Fisheries, Seattle, Wash.
Shirley M. Clark, and George R. Snyder.
Limnology and Oceanography, Vol 14, No 6, November 1969, p 960-965. 3 fig, 2 tab, 3 ref.

Descriptors: *Cooling water, *Tidal effects, *Stagnant water, *Thermal powerplants, Heated water, Water temperature, Low flow, Tracers, Columbia River, Thermal pollution.
Identifiers: *Flow reversal.

Tracer study showed that because of the effect of tides, an extensive upstream movement of water can occur near Prescott during low flow stages of the Columbia River. Under these conditions, thermal electric plants would use the same water more than once for cooling their condensers and repeatedly subject fixed masses of water to their heated effluents. The reversal of the river would cause a periodic concentration of rejected heat from the thermal electric plant in sections of the river downstream producing an increase in the temperature of isolated volumes of water that is above the average rise for the river. Temperature rise was estimated. The study points out that this problem should be studied intensively to evaluate the biological risk before final designs of the proposed installations of power plants are accepted. (Hsieh-Vanderbilt)
W70-08831

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DEVELOPMENT OF NEW REVERSE OSMOSIS MEMBRANES FOR DESALINATION,
North Star Research and Development Inst., Minneapolis, Minn.
L. T. Rozelle, J. E. Cadotte, and D. J. McClure.
For sale by Superintendent of documents, US Government Printing Office, Wash, DC 20402, Price $1.25. US Office of Saline Water Research and Development Progress Report No 531, June 1970. 124 p, 21 fig, 24 tab, 26 ref, 3 append. Contract No 14-01-0001-1696 OSW.

Descriptors: *Membranes, *Desalination, *Reverse osmosis, *Cellulose, *Plastics, Desalination processes, Permselective membranes, Semipermeable membranes, Research and development, Laboratory tests, Thin films, Permeability.
Identifiers: Ultrathin membranes.

A process was developed for forming ultrathin membranes by casting a cellulose acetate solution on a water surface. These membranes can provide greater than 99 percent salt rejection, and they could be formed as thin as 500 angstroms. A promising support film of polysulfone was also developed. The feasibility of casting ultrathin cellulose acetate membranes and the polysulfone support films in tubes was proved and the casting variables defined. These ultrathin membranes, along with the polysulfone support films, were successfully applied to commercial tubes and tested. Several successive membrane removals and replacements were carried out successfully in the commercial tubes without manual manipulation of the module. A number of new ultrathin membranes from mixed esters and ethers of cellulose acetate were found to exhibit water flux and flux decline properties superior to cellulose acetate. (Knapp-USGS)
W70-08932

SMALL DESALINATION UNIT TO TEST SCALE-REDUCTION ADDITIVES,
Rhode Island Univ., Kingston. Dept. of Chemical Engineering.
Niels Madsen.
Available from the Clearinghouse as PB-193 411, $3.00 in paper copy, $0.65 in microfiche. Completion Report, 1969. 19 p. OWRR Project A-020-RI (1).

Descriptors: *Desalination, *Scaling, *Flash distillation, *Heat transfer, *Model studies, *Testing, *Additives, *Scale deposition, *Scale prevention, *Multiple flash distillation, *Simulation.

A mathematical model of the reduction in the heat-transfer rate with elapsed time, when a scaling fluid is heated, is given. Considerations that were made during the design of a semi-portable heat transfer apparatus for simulating the heating of sea water in a multi-stage flash evaporation unit are presented. The results of several preliminary calibrations and tests, including a 12 hr. run with the maintenance of flow rate, outlet temperature, outlet pressure, and temperature driving force are presented. The testing was done with non-scaling water only. (Madsen-Rhode Island)
W70-08985

MODIFYING THE WATER BALANCE BY DESALINATION,
Geological Survey, Washington, D.C.; and Office of Saline Water, Washington, D.C.
Francis A. Kohout, and Milton S. Sachs.
In: Proceeding of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association, Urbana, Illinois, p 214-222, 1969. 4 fig, 19 ref.

Descriptors: *Desalination, *Water costs, *Water balance, Water utilization, Water supply, Surveys, Reviews, Economics, Municipal water, Water resources development, Saline water, Groundwater, Saline water systems.
Identifiers: Desalination costs.

Desalination costs have decreased from about $5/1000 gallons in the early 1950's to about $1/1000 gallons for sea-water distillation in the late 1960's. These costs do not include delivery to the consumer. Because of the high cost, desalination has been considered as an alternate water-supply scheme where fresh-water deficiencies are great. However, two of the largest desalting plants in the United States are located in Florida, where annual

rainfall averages 50 to 60 inches per year. The seeming contradiction is related to subjective factors not always considered in the balance of conventional vs. desalted water costs. For example, public health departments and consumers in some areas are demanding better water than Nature can provide at an economical distance from the point of use. Desalination of previously unused, onsite saline water creates completely controllable, potable water which is free from economic, legal and political entanglements. Desalination is a factor that can be expected to substantially affect the water balance of North America. (See also W70-08597)
W70-08996

3B. Water Yield Improvement

LAND MANAGEMENT IN MUNICIPAL WATERSHEDS,
For primary bibliographic entry see Field 06E.
W70-08797

STATUS OF PILOT WATERSHED STUDIES IN ARIZONA,
Forest Service (USDA), Flagstaff, Ariz.
Harry E. Brown.
ASCE Proceedings, Journal of the Irrigation and Drainage Division, Vol 96, No IR 1, Paper 7129, p 11-23, March 1970. 11 fig, 30 ref.

Descriptors: *Small watersheds, *Demonstration watersheds, *Water yield improvement, *Rainfall-runoff relationships, *Arizona, Soil-water-plant relationships, Vegetation effects, Clear-cutting, Evapotranspiration control.
Identifiers: Experimental watersheds (Arizona).

Critical water shortage in Arizona have led to intensive investigations of methods for increasing streamflow from the State's watersheds. These investigations include research studies of hydrologic processes and behavior, pilot tests of promising treatments, economic studies, and surveys of potentially treatable areas. Results are reported from pilot tests in chaparral, juniper, ponderosa pine, and mixed conifer vegetation types. To date, streamflow responses following watershed treatments have varied from zero to as much as 9 inches per year, depending on the nature of the treatment, type of vegetation, and climate. These results and others forthcoming will play an important role in future multiple use management of forest lands in Arizona. (Knapp-USGS)
W70-08946

NEW WATER FOR NORTHERN PLAINS,
South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences.
Richard A. Schleusener.
ASCE Proceedings, Journal of the Irrigation and Drainage Division, Vol 96, No IR1, Paper 7145, p 53-60, March 1970. 1 fig, 1 tab, 6 ref. Contract No 14-06-D-5979 (Bu Rec), Contract No N60530-67-C-1289 (Navy).

Descriptors: *Cloud seeding, *Water yield improvement, *Weather modification, Projects, Artificial precipitation, Nucleation, Rainfall, On-site tests, Research and development, Analytical techniques, On-site investigations, Resource development.
Identifiers: Northern plains.

Current research in cloud seeding follows a plan to progress from experimental projects on individual clouds (or areas less than 1,000 sq miles) to pilot projects involving several thousand square miles to operational projects over areas of thousands of square miles. Research to date has shown that individual clouds exist that can be made to produce additional precipitation by seeding, and a beginning has been made on defining the meteorological conditions for which cloud seeding can produce additional usable precipitation. Results of cloud seeding for hail suppression are mixed. Pilot projects extending over several thousand square miles are now needed to determine whether the effects found on experimental projects can be extended to larger areas. There is a need to leave a limited number of cases (randomly selected) unseeded as controls to monitor the effects of the weather modification treatment. It is proposed that the fraction left unseeded change from 50% for experimental projects to 25% for pilot projects to 10% for operational projects. (Knapp-USGS)
W70-08950

RESPONSIBILITY IN WEATHER MODIFICATION OPERATION,
Fresno State Coll. Foundation, Calif. Atmospheric Water Resources Research; and South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences.
Merlin C. Williams, and Richard A. Schleusener.
ASCE Proceedings, Journal of the Irrigation and Drainage Division, Vol 96, No IR1, Paper 7171, p 61-66, March 1970. 6 ref.

Descriptors: *Weather modification, *Water yield improvement, *Water law, *Regulation, Legal aspects, Management, Permits, Standards.
Identifiers: Weather-management regulation.

Recent experience has shown that weather modification can be used to produce beneficial changes in atmospheric processes. The possibility of using this new technology as a watershed management tool requires consideration of the conditions under which the tool is used and the responsibilities required for its use. Evidence resulting from a number of projects indicates that both benefit and disbenefits may result from treatment of extremely variable weather systems. The need for responsible operations can be met by assuring that the individuals involved in these activities have the requisite experience, education and ethical standards. A means for meeting this need is proposed through the identification of individuals with the necessary qualifications on a basis similar to engineering registration. (Knapp-USGS)
W70-08951

PHYSIOGRAPHY-LAND USE INTERACTIONS IN WATERSHED MANAGEMENT,
British Columbia Univ., Vancouver. Dept. of Forestry.
For primary bibliographic entry see Field 05B.
W70-08989

VEGETATION MANAGEMENT FOR WATER YIELD,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
Marvin D. Hoover.
In: Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association, Urbana, Illinois, p 191-195, 1969. 8 ref.

Descriptors: *Water yield improvement, *Forest management, *Watershed management, Water yield, Economics, Clear-cutting, Lumbering, Planting management, Vegetation effects, Rainfall-runoff relationships.
Identifiers: Vegetation management.

Large-scale management of forest lands for water may be possible because they are held in large blocks and much is publicly owned. Yield increases tend to be greater during normally high runoff periods and in wet years. Economic value of such yield increases depends on water uses in the basin and on available storage. Large areas in the West approach ideal vegetation patterns and are now yielding near their potential. Where tree products are merchantable, water increase can be a valuable by-product of timber harvesting. However, where timber is of low wood value or high efficiency in water production is desired, financing for water improvement must be found. Artificial augmentation of precipitation appears to offer promise for mountain areas which are often forest covered. Successful weather modification would increase the efficiency of vegetation management practices. (See also W70-08597)
W70-08991

CLOUD SEEDING AND RAIN MAKING,
Alberta Univ., Edmonton. Dept. of Meteorology.
Richmond W. Longley.
In: Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association, Urbana, Illinois, p 196-200, 1969. 10 ref.

Descriptors: *Cloud seeding, *Water yield improvement, *Reviews, Economics, Testing, Appraisals, Evaluation, Projects.
Identifiers: Cloud seeding evaluation.

The present status of cloud seeding to produce rain is reviewed. Some trials have indicated a 20 percent increase of rain. Other trials are inconclusive. As yet there is no clear evidence on the 'side-effects' of cloud seeding. Further experiments must be made to insure that cloud seeding in one area does not adversely affect people in another area. Also it is necessary to examine further the reasons why seeding is effective in some situations and ineffective in other situations. (See also W70-08597)
W70-08992

SOME RECENT RESEARCH IN EVAPORATION SUPPRESSION,
Geological Survey, Denver, Colo.
G. Earl Harbeck, Jr.
In: Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association, Urbana, Illinois, p 201-213, 1969. 30 ref.

Descriptors: *Evaporation control, *Monomolecular films, *Reviews, Research and development, Seepage, Reservoir evaporation, Water conservation, Reservoir leakage.
Identifiers: Geological Survey, Bureau of Reclamation.

Since 1960 considerable research has been conducted in the use of monomolecular films to suppress evaporation. The studies of the U.S. Geological Survey and the U. S. Bureau of Reclamation are reviewed. The Bureau of Reclamation also financed many other research projects in this field undertaken by universities in the Rocky Mountain region. Much of the research was on methods of applying and maintaining a film; the most successful techniques were film application using powder, in emulsions, or by spraying molten material. Evaporation savings for the larger reservoirs were mostly about 20 percent or less. An unexpected and unwelcome finding was that under some circumstances, seepage losses from small stock ponds may be increased by the application of a monolayer. (See also W70-08597)
W70-08993

POTENTIAL EFFECTS OF SPRINKLED AGRICULTURE ON THE NORTH AMERICAN WATER BALANCE,
California Univ., Davis. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 02A.
W70-08995

3C. Use of Water of Impaired Quality

WASTE WATER FOR GOLF COURSE IRRIGATION,
California State Water Resources Control Board, Goleta.
For primary bibliographic entry see Field 05D.
W70-08962

3E. Conservation in Industry

WATER FOR INDUSTRIAL DEVELOPMENT IN CLARKE, JASPER, LAUDERDALE, NEWTON, SCOTT, AND SMITH COUNTIES,
Geological Survey, Jackson, Miss., Water Resources Div.
E. H. Boswell, F. H. Thomson, and D. E. Shattles.
U S Geological Survey Open-file (duplicated) Report, 1970. 62 p, 32 fig, 9 tab, 18 ref.

Descriptors: *Water resources, *Industrial water, *Mississippi, Groundwater, Streamflow, Water quality, Hydrogeology, Data collections, Hydrologic data, Water resources development, Aquifers, Water wells.
Identifiers: Clark County, Jasper County, Lauderdale County, Newton County, Scott County, Smith County.

Detailed information is presented on the availability, chemical quality, and physical characteristics of groundwater and surface water of this six-county area in east-central Mississippi. Designed as a guide for planning and developing industrial water supplies, the report contains 32 illustrations and 9 data tables. Illustrations include 14 maps, 6 geohydrologic sections, 4 flood profiles, and several graphs showing duration of low streamflow, relation of dissolved solids to discharge and time-drawdown relations of aquifers. In 85% of the area, at least one aquifer contains water suitable for general use with little or no treatment; the water is a soft sodium bicarbonate type usually with dissolved-solids content below that recommended for most industrial uses. Wells designed for high production can yield more than 15 mgd at many places. The fresh-water section averages 1,500 ft thick and attains about 3,500 ft in Smith County. In 80% of the area, low-flow yields are less than 0.05 cfs per sq mi. Average low-flow discharge from the area is 65 mgd, mostly by the Chickasawhay and Leaf Rivers; the streamflow is of good quality. Potential is large for development of surface supplies from storage reservoirs. (Lang-USGS)
W70-08589

3F. Conservation in Agriculture

2,4-D CONTAMINATION AND PERSISTENCE IN IRRIGATION WATER,
Bureau of Reclamation, Denver, Colo.
For primary bibliographic entry see Field 05B.
W70-08681

SPRINKLERS AND VEGETABLE CROP MECHANIZATION IN DESERT AREAS,
California Univ., Riverside; and California Univ., Indio. Agricultural Extention Service.
Hunter Johnson, Jr., Albert W. Marsh, and G. Neil McRae.
Preprint. PCR-69-131, 1969 Annual Convention, Pacific Coast Region, American Society of Agricultural Engineers, Phoenix, Arizona, Mar 1969. 13 p, 1 fig, 7 tab, 8 ref.

Descriptors: *Sprinkler irrigation, *Vegetable crops, *Deserts, Crops, *Arid lands, *Vegetables, *Furrow irrigation, Planting management, Plant growth, Agriculture, Irrigation, Southwest U.S., Farm management, Saline soils, Mechanization, Seeding, Crop production, Crop response, Salinity, California, Lettuce.
Identifiers: *Comparative studies, *Crop yield, Night, Precision Planting, High temperature, Coachella Valley, Calif.

Field studies were conducted on arid mechanized farms in California to evaluate the use of sprinkler and furrow irrigation on plantings of lettuce and cabbage. The studies provided substantial evidence that major improvement in germination and emergence can be expected with sprinkler irrigation when compared with the standard practice of furrow irrigation. This response can be attributed to seed-zone salt control, but additional benefits might be expected from improved soil aeration. During high-temperature periods, growers might expect greater response to sprinkling if irrigation begins at night. If better germination can be assured with sprinklers, precision planting on saline soils will become practical. Because precision planting is the first important step in mechanized culture of vegetable crops, sprinklers will be an indispensable tool in mechanization--particularly in desert areas. (USBR)
W70-08688

WATER IN THE DESERTS,
Office of Water For Peace, Washington, D.C.
For primary bibliographic entry see Field 06B.
W70-08689

GROWTH, YIELD, AND YIELD COMPONENTS OF SAFFLOWER AS AFFECTED BY IRRIGATION REGIMES,
Arizona Agricultural Experiment Station, Tucson.
For primary bibliographic entry see Field 02I.
W70-08818

SCHEDULING IRRIGATIONS USING CLIMATE-CROP-SOIL DATA,
Agricultural Research Service, Kimberly, Idaho. Snake River Research Center; Bureau of Reclamation, Denver, Colo.; and Salt River Valley Water Users' Association, Phoenix, Ariz.
Marvin E. Jensen, David C. N. Robb, and C. Eugene Franzoy.
ASCE Proceedings, Journal of the Irrigation and Drainage Division, Vol 96, No IR1, Paper 7131, p 25-38, March 1970. 1 fig, 3 tab, 30 ref, append.

Descriptors: *Irrigation efficiency, *Irrigation engineering, *Irrigation practices, *Irrigation design, *Timing, Irrigation systems, Digital computers, Water management (Applied), Water utilization, Soil-water-plant relationships, Water distribution (Applied), Evapotranspiration.
Identifiers: Irrigation scheduling.

The most important factor affecting irrigation efficiencies and crop yields is scheduling irrigations in time and amount. Overirrigation may result in waterlogged soils, a condition which reduces yields and generally results in increased costs for water, fertilizer, and drainage. Water use is at a minimum when the amount of water applied is just equal to the consumptive use and the leaching requirement. To achieve higher irrigation efficiencies, present irrigation scheduling practices must be improved. Irrigation scheduling using climate-crop-soil data, computers to facilitate the tedious computations, and field observations by experienced personnel is a service that appears to be very attractive to the modern irrigation farm manager. This service has the potential of increasing the management skills of the farmer and his net return at a reasonable cost. It supplements the art of irrigation or experienced judgement with the results of recent advances in irrigation science. (Knapp-USGS)
W70-08947

SURFACE IRRIGATION USING KINEMATIC-WAVE METHOD,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 06A.
W70-08948

SUBSURFACE IRRIGATION EASILY AUTOMATED,
California Univ., Riverside. Agricultural Research Service.
Sterling Davis, and Sheldon D. Nelson.
ASCE Proceedings, Journal of the Irrigation and Drainage Division, Vol 96, No IR1, Paper 7135, p 47-51, March 1970. 4 fig, 9 ref.

Descriptors: *Automation, *Irrigation design, *Subsurface irrigation, Irrigation engineering, Pipes, Automatic control, Mechanical control, Distribution systems.
Identifiers: Automated irrigation.

Subsurface irrigation applies water directly into the root zone of the crop and may easily be automated. Two subsurface irrigation systems are described: an automatic float-operated device to supply water needed to a tree or plants; and a plastic hose with inserts, planted with the potato seed and picked up with the mature potatoes. (Knapp-USGS)
W70-08949

POTENTIAL EFFECTS OF SPRINKLED AGRICULTURE ON THE NORTH AMERICAN WATER BALANCE,
California Univ., Davis. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 02A.
W70-08995

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

AN APPROACH TO DETERMINE THE MINIMUM ALLOWABLE FLOW IN THE 'TISZA' RIVER FROM THE VIEWPOINT OF WATER QUALITY,
Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 05B.
W70-08633

MILHOUS V STATE HIGHWAY DEP'T (UNCONSTITUTIONAL TAKING OF PROPERTY FOR PUBLIC USE VIA OBSTRUCTION OF NATURAL FLOW OF SURFACE WATERS).

8 SE2d 852-857 (S C 1940).

Descriptors: *South Carolina, *Obstruction to flow, *State governments, *Eminent domain, *Highway effects, Surface drainage, Surface runoff, Alteration of flow, Drainage practices, Drainage systems, Legal aspects, Judicial decisions, Condemnation, Public rights, Relative rights, Right-of-way, Roadbanks, Highways, Administrative agencies, Repulsion (Legal aspects), Riddance (Legal aspects), Surface waters, Ditches, Reservoirs, Impounded waters.
Identifiers: *Constitutions.

Plaintiff landowner contended that defendant Highway Department had taken his property for public use without just compensation. Defendant allegedly had razed the grade of the road adjacent to plaintiff's property, had destroyed a pit previously serving as a temporary reservoir for surplus rainfall, and had replaced a drainage ditch with inadequate ones. Plaintiff's drainage was rendered inadequate and his land flooded. Defendant sought to distinguish surface water from natural watercourses, and contended it would be liable only if it collected surface water and threw it with force onto the land of another. The appellate court held that, as to the state, liability exists whether the taking of the property is by stream obstruction, by casting impounded surface water with force on another's land, or by the obstruction of the natural flow of surface water. Under the common law an individual may defend his property against surface waters under the common enemy rule, and he is not liable for resulting damages to his neighbor's lands. However, the common law and the Constitution afford a remedy against the state for one whose property is unconstitutionally taken. (Price-Florida)
W70-08703

KEENER V ADDIS (DAMAGES FROM DRAINAGE DITCH DISCHARGE).

5 SE2d 695-703 (Ga Ct App 1939).

Descriptors: *Georgia, *Ditches, *Riddance (Legal), *Repulsion (Legal aspects), Damages, Drainage effects, Drainage, Conveyance structures, Drainage engineering, Water conveyance, Surface drainage, Drainage practices, Surface waters, Sediment discharge, Routing, Gravels, Sediments, Sands, Crops, Crop production, Farms, Judicial decisions, Legal aspects, Land use, Impounded waters.

Plaintiff brought action to recover from defendant for injury done plaintiff's land and crops by water from a drainage ditch built by defendant. Plaintiff alleged that defendant had collected surface water on his land and by way of the ditch had discharged it onto plaintiff's property. The water, sand and gravel deposited on plaintiff's land resulted in the land's becoming unfit for the production of crops. Defendant contended that plaintiff was under a duty to avoid the consequences of the alleged nuisance. The Court of Appeals of Georgia ruled that plaintiff was under no duty to avoid the consequences since such duty arises only where the act complained of is a negligent act. The facts showded a positive act by defendant, not negligence. The measure of damages was the actual loss caused by the injury to the property. The trial court's judgment for the plaintiff was affirmed. (Barker-Florida)
W70-08714

GROOVER V HIGHTOWER (FLOOD DAMAGE FROM DAM CONSTRUCTION).
1 SE2d 446-449 (Ga Ct App 1939).

Descriptors: *Georgia, *Dams, *Damages, *Obstruction to flow, Natural flow doctrine, Streamflow, Riparian rights, Relative rights, Dam construction, Damsites, Sites, Sediment control, Barriers, Dam design, Overflow, Water control, Flood damage, Crops, Crop production, Sediments, Land use, Judicial decisions, Legal aspects, Flooding, Floods.

Plaintiff upstream landowners brought action for damages against defendant for injury caused to plaintiff's crops and land as a result of a dam built by defendant downstream from plaintiff's property. Plaintiff claimed that the water from the stream had backed up, thereby flooding his land and preventing the production of corn. Plaintiff also contended that the dam had restricted the flow of the stream so that sand, trash and other matter had accumulated in the stream which further contributed to the overflowing and flooding of his land. Defendant argued that the water had not backed up as far as plaintiff alleged and that the flow through plaintiff's land had not been impeded by construction of the dam. The trial court excluded defendant's testimony as to the rate of flow and the jury returned a verdict for plaintiff. The Court of Appeals of Georgia ruled that the evidence as to whether the dam retarded the flow should have been submitted to the jury. The trial court's decision was reversed. (Baker-Florida)
W70-08715

DICKEY V YARBROUGH (EXECUTION OF PAROL LICENSE BECOMES EASEMENT TO USE OF DITCH).
197 SE 234-235 (Ga 1938).

Descriptors: *Georgia, *Easements, *Obstruction to flow, *Ditches, Flow, Ponds, Legal aspects, Judicial decisions, Flow resistance, Flow control, Drainage, Drainage water, Remedies, Damages, Water injury, Water transfer, Cultivation, Expenditures, Land clearing, Relative rights.
Identifiers: *Injunction (Permanent).

Plaintiff and defendant were adjoining landowners. A pond on plaintiff's land flowed into a ditch which extended onto defendant's property. Defendant granted a parole license to plaintiff which authorized him to open and use the ditch in order to drain the pond. In reliance upon such authorization, plaintiff expended six dollars for the purpose of clearing the ditch. However, defendant subsequently threatened to close the ditch and actually placed obstructions therein. Plaintiff sought an injunction to prevent defendant from placing further obstructions in the ditch and from interfering with plaintiff's use of the ditch. Plaintiff maintained that if the ditch were closed, water would accumulate on his land and thereby cause him to incur damages, since a number of acres would be unfit for use and cultivation. In holding for plaintiff, the court stated that the parole license to open and use the ditch for the purpose of draining plaintiff's pond was irrevocable, and that plaintiff executed the license in making an expenditure, which converted such license into an easement running with the land. (Finman-Florida)
W70-08716

ELDER V BARNES (UPPER LANDOWNER REQUIRED TO REMOVE OBSTRUCTIONS FROM NATURAL DRAINAGE SYSTEM).

219 N C 411, 14 SE2d 249-252 (1941).

Descriptors: *North Carolina, *Obstruction to flow, *Natural streams, *Drainage systems, Depth, Downstream, Flow, Natural flow, Non-navigable waters, Surface waters, Channel improvement, Drainage, Legal aspects, Judicial decisions, Adjudication procedure, Natural flow doctrine, Relative rights, Riparian land, Riparian rights, Riparian waters, Surface runoff, Remedies, Repulsion (Legal aspects), Riddance (Legal aspects).

Plaintiff upper riparian landowner sought an order requiring defendant lower landowner to remove obstructions from a branch which ran through defendant's land and which had been the natural drain for plaintiff's land for forty years. The obstruction had caused water to collect on plaintiff's property. Defendant was ordered by the lower court to clear the branch and to improve a portion of it by constructing a ditch therein. Plaintiff was to improve another section of the branch in a like manner. Plaintiff complied with the order, but the defendant did not. The appellate court held that the evidence was sufficient to sustain the order of the lower court finding the defendant in contempt. Moreover, the lower court had acted within its power. The order was affirmed. (Price-Florida)
W70-08732

RICHMOND V DRAINAGE COMM'RS (RIGHT OF ACCESS TO LAND ACROSS DRAINAGE DITCH).
295 Ill App 338, 15 NE2d 6-8 (1938).

Descriptors: *Illinois, *Drainage districts, *Access routes, *Bridge construction, Bridges, Drainage systems, Local governments, Ditches, Tile drainage, Drains, Farms, Land tenure, Legislation, Administration, Judicial decisions, Legal aspects, Relative rights, Remedies, Administrative agencies.
Identifiers: Mandamus.

Plaintiff, in a petition for mandamus, sought an order requiring defendant drainage district to rebuild a bridge across a ditch running through plaintiff's farm. Defendant contended it was under no legal obligation to build the bridge. The court held that under the state's existing Farm Drainage Act the commissioners were not required to build the bridge. However, under a 1927 act plaintiff had the right, if necessary for free access to an enclosed parcel of land, to require the drainage district to build the bridge across the drain. The court noted that the area to which access was sought was enclosed by fences, and it would be necessary for plaintiff to travel a distance of four miles to reach the land if the bridge were not built. Therefore, the court found the site in question to be an 'enclosed' parcel of land within the meaning of the statute and held for plaintiff. (Hubener-Florida)
W70-08738

DANFORTH V UNITED STATES (TAKING OF LAND FOR LEVEE CONSTRUCTION).
For primary bibliographic entry see Field 06E.
W70-08748

LYNN V UNITED STATES (EMINENT DOMAIN: COMPENSATION FOR OBSTRUCTION OF LAND DRAINAGE CAUSED BY INCREASED BACKWATER LEVEL).
For primary bibliographic entry see Field 06E.
W70-08749

IN RE COUNTY DITCH NO 50, FARIBAULT COUNTY (PARTIES DIRECTLY AND INDIRECTLY AFFECTED BY LATERAL DRAIN AND DITCH IMPROVEMENT PROCEEDINGS).
For primary bibliographic entry see Field 06E.
W70-08759

NIGHTINGALE V STATE (CLAIM FOR DAMAGES DUE TO EROSION CAUSED BY CANAL OPERATION).
For primary bibliographic entry see Field 06E.
W70-08765

HASKELL V STATE (NEGLIGENT OPERATION OF FLOOD CONTROL FACILITIES).
For primary bibliographic entry see Field 06E.
W70-08769

LOHMEYER V STATE (FLOOD DAMAGE CAUSED BY DEBRIS BLOCKING ARCHWAY OF STATE AQUEDUCT).
For primary bibliographic entry see Field 06E.
W70-08776

HOMES, INC V ANDERSON (RIGHT TO DIRECT DRAINAGE WATER ALONG NATURAL COURSE OF FLOW).
For primary bibliographic entry see Field 06E.
W70-08779

COX V DRAINAGE DIST NO 27 (NOTICE OF HEARING BY DRAINAGE DISTRICT REQUIRED FOR ADDITIONAL ASSESSMENTS).
For primary bibliographic entry see Field 06E.
W70-08782

GRAVES V LITTLE TARKIO DRAINAGE DIST NO 1 (FINANCING RECLAMATION PROJECTS).
For primary bibliographic entry see Field 06E.
W70-08785

HOGAN V COWART (DUTY NOT TO OBSTRUCT DRAINAGE THROUGH DITCH ACQUIRED BY EASEMENT).
For primary bibliographic entry see Field 06E.
W70-08787

KIRK V NORFOLK AND W RY (RECOVERY FOR PERMANENT WATER INJURY BARS FUTURE RECOVERY OF DAMAGES).

196 SE 501-503 (W Va 1938).

Descriptors: *West Virginia, *Pipes, *Railroads, *Overflow, Flow control, Remedies, Water injury, Damages, Flooding, Real property, Judicial decisions, Legal aspects, Darinage water, Drainage effects, Drainage systems, Surface waters, Flood control, Construction, Maintenance, Right-of-way, Flood damage, Floodwater.
Identifiers: *Permanent nuisance, Damages (Permanent).

Plaintiff owned a tract of land, abutting defendant railway company's roadbed and tracks, which defendant had constructed pursuant to a right-of-way granted by plaintiff's predecessor in title. Waters from nearby hills overflowed onto the tract through two drain pipes which defendant maintained under

its roadbed. Preciously, defendant had been held liable to plaintiff's predecessor in title for such damages to the tract which resulted from the flooded condition caused by this drainage. Subsequently, plaintiff purchased the tract and brought action to recover temporary damages from defendant which resulted from waters being drained onto plaintiff's property through the same drain pipes. Defendant contended that plaintiff was prohibited from collecting damages since a judgment for permanent injury had previously been awarded against defendant involving this same real property. The court held that the previous judgment and award of permanent damages to plaintiff's predecessor in title against defendant was a bar to plaintiff's recovery. As the construction and maintenance of the drain pipes under the roadbed caused a nuisance of a permanent nature, the court stated that the recovery of damages in the prior suit was permanent and final. (Finman-Florida)
W70-08789

BD OF EDUC V TOWN OF N HEMPSTEAD (LIABILITY FOR DIVERSION OF SURFACE WATERS).
For primary bibliographic entry see Field 06E.
W70-08791

MENNITO V TOWN OF WAYLAND (LIABILITY FOR DAMAGES RESULTING FROM THE ALTERATION OF SURFACE DRAINAGE).
For primary bibliographic entry see Field 06E.
W70-08793

TENNESSEE A AND G RY V CARDON (DUTY TO MAINTAIN ADEQUATE DRAINAGE AFTER CONSTRUCTION OF DITCHES).
For primary bibliographic entry see Field 06E.
W70-08795

MODIFICATION OF THE RIPARIAN THEORY AND DUE PROCESS IN MISSOURI,
James D. Ellis.
Missouri Law Review, Vol 34, 1969, p 562-574.

Descriptors: *Missouri, *Riparian rights, *Water rights, *Prior appropriation, Water law, Permits, Water permits, Legal aspects, Legislation, State governments, Judicial decisions, Control, Administrative agencies, Regulation, Public health, Water allocation (Policy), Planning, Water policy.

The inefficiency and wasteful methods of regulating water use under the riparian doctrine have led some states to depart from riparian theory in favor of comprehensive regulatory acts concerning water use. Such states as South Dakota, Kansas, Oregon, Minnesota and Iowa have all followed this course and provide possible models for Missouri in changing riparian control. These acts generally preserve vested riparian interests as long as they are used in a beneficial manner. Courts have upheld the acts as valid exercises of the police power. Some of the acts provide for a state agency to establish a permit system to regulate the appropriation of water. The crucial question in state regulation is whether a riparian owner is entitled to compensation if his rights to the water are impaired. A South Dakota court has held that water rights are not sufficient property interests to allow the invocation of the right not to be deprived of property without due process of law, although that theory may not be acceptable in Missouri. However, it is possible that unexercised riparian rights may be curtailed without compensation being given. (Hubener-Florida)
W70-08811

ZONING THE FLOOD PLAINS OF OHIO.
Toledo Law Review, Vol 1969, p 655-676.

Descriptors: *Ohio, *Flood plain zoning, *Land use, *Rivers, Cities, Urbanization, Industries, Local governments, Sites, Water utilization, Regulation, Legislation, Flood plains, Flood damage, Building codes, Flood control, Flood plain insurance, Flood protection, Legal aspects, Regulation.

Prevention of flood damage can be accomplished most effectively by sound flood control programs and regulation of land development in areas subject to flooding by such means as zoning, subdivision regulation, building codes and community development policies. Flood plain zoning ordinances may be enacted pursuant to a state's police power if they are within the scope of state zoning enabling statutes. The most useful policy would be to permit some industries which are highly dependant upon water to locate within the flood plain if they would adopt necessary modes of floodproofing. However, residential areas should be excluded from flood plains since they have no need for locating near water and generally cannot afford the costs of floodproofing. In Ohio such zoning practices have been successfully utilized in urban areas but have not been effective in rural areas. The trend in Ohio is to the increasing use of restrictions on flood plain development. Increasing use of regulations should be spurred by the fact that such regulations are required for communities to qualify for federal flood insurance under the 1968 Housing Act. (Hubener-Florida)
W70-08813

COLE V BRADFORD (NO DUTY TO SHARE EXPENSES FOR REMOVING NATURALLY OCCURRING OBSTRUCTIONS).
184 SE 901-902 (Ga Ct App 1936).

Descriptors: *Georgia, *Obstruction to flow, *Natural flow, *Riparian rights, Remedies, Legal aspects, Judicial decisions, Riparian land, Riparian waters, Natural flow doctrine, Alteration of flow, Diversion, Water law, Overflow, Streamflow, Streams, Expenditures, Real property, Water injury, Duty of water, Relative rights.

Naturally occurring obstructions from defendant's lower riparian property caused stream water to overflow onto plaintiff's upper riparian land. Plaintiff requested permission to enter defendant's land, after due notice, in order to clear the stream of such obstructions, and furthermore requested defendant to share the expenses of removing these obstructions. Defendant permitted plaintiff to enter upon his property to clear the stream, but insisted that this was to be done at plaintiff's own expense. Plaintiff brought action to compel defendant to share these expenses. The court stated the rule that an upper riparian owner is entitled to have the water of a stream flow naturally from his land, but a riparian owner is not to be held responsible for the effects of nature which cause obstructions in a stream. Furthermore, such riparian owner owes on duty to either a lower or upper riparian owner to remove such naturally occurring obstructions. Therefore, as defendant was under no duty to remove these obstructions, the court held he was not liable to share plaintiff's expenses in removing such obstructions. (Finman-Florida)
W70-08821

COMM'RS OF UNION DRAINAGE DIST NO 1 v COMM'RS OF UNION DRAINAGE DIST NO 2 (APPORTIONING COSTS OF DRAINAGE DISTRICT IMPROVEMENTS).
373 111 347, 26 NE 2d 85-88 (1940).

Descriptors: *Illinois, *Drainage districts, *Drainage systems, *Cost sharing, Cost repayment, Local governments, Ditches, Drains, Farms, Land tenure, Bridge construction, Legislation, Administration, Judicial decisions, Legal aspects, Compensation, Bridges, Flood control, Silting, Watersheds (Basins), Administrative agencies, Administration.

The commissioners of plaintiff drainage district instituted this proceeding to determine what share of the cost of cleaning and widening the main ditch in their district should be borne by defendant, an adjoining drainage district. Plaintiffs also requested that defendants should bear a portion of the costs of lengthening bridges spanning the ditch. Although evidence conflicted as to the benefits defendants obtained from the project and from plaintiffs' drainage ditch, the court held that the preponderance of the evidence showed defendant district was benefited by the cleaning and widening of the ditch in question. Since the land in both districts was part of the same watershed, and since plaintiffs' land sloped gradually down into defendants' land, the court noted that land would be flooded in both districts if no ditches were constructed. Defendant would also be benefited in that water would flow faster from plaintiffs' ditch and tend to loosen silt in defendants' ditch. The court ordered that costs be shared in proportion to the area of land in each district. Also, a share of the cost of bridge lengthening was properly chargeable to defendants. (Hubener-Florida)
W70-08823

R DUNKEL, INC V BARLETTA CO (OBSTRUCTION OF UNDERGROUND STREAM).
18 NE2d 377-379 (Mass 1938).

Descriptors: *Massachusetts, *Streamflow, *Obstruction to flow, *Conduits, Alteration of flow, Average flow, Culverts, Structures, Cofferdams, Outlet works, Overflow, Control structures, Damages, Legislation, State governments, Underground, Subsurface waters, Underflow, Judicial decisions, Legal aspects, Construction.
Identifiers: *Negligence.

A creek flowed through a culvert located beneath the floor of a basement in plaintiff's buildings. Following a heavy rain, water overflowed the culvert and entered the basement, causing damage to goods stored therein. Plaintiff sued defendants who were constructing a conduit to lead water away from plaintiff's premises. Plaintiff alleged that negligent methods caused obstruction to the flow of the creek which resulted in the overflow into his basement. Plaintiff contended that creation of the obstruction was negligence per se. The court, in holding for defendants, stated that the conduit could not have been constructed without obstructing flow and, therefore, defendant was not liable unless the erection of the obstruction was performed in a negligent manner. The question of negligence was for a jury to decide. As the acts of defendants were required in the performance of a contract with the state, plaintiff's remedy was confined to the means provided in the statute which authorized the construction of the conduit. (Hubener-Florida)
W70-08839

WATERSHED MODELING BY ELECTRONIC ANALOG COMPUTER,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 06A.
W70-08860

PERFORMANCE OF AN ASPHALT TREATED DRAINAGE BLANKET IN A FLEXIBLE PAVEMENT SECTION,
California State Div. of Highways. Materials and Research Dept.
Travis Smith, Raymond Forsyth, and Wesley Gray.
Interim Report M and R No 632618, Dec 69, 43 p, 14 fig, 4 tab, 7 ref.

Descriptors: *Paving, *Drainage, *Highways, Road construction, Asphalt, California, Performance.
Identifiers: Drainage blankets, *Flexible pavements.

The paper presents the results of a field evaluation of a two-layer highway drainage system on Road 299 between Arcata and Willow Creek in the northern coastal region of California. The experimental section consisted of 400 feet utilizing a two-layer drainage blanket, the top, or drainage element, of which was stabilized with asphalt and 200 feet of normal single-layer drainage blanket to

serve as a control. The section was located in a cut section with numerous springs and seeps in a high rainfall area. Both sections effectively drained all subsurface water at the site through an unusually wet winter and spring.
W70-09005

4B. Groundwater Management

RESISTANCE NETWORK FOR THREE-DIMENSIONAL UNCONFINED GROUNDWATER PROBLEMS WITH EXAMPLES OF DEEP WELL DEWATERING,
Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton, and R. Herbert.
The Institute of Civil Engineers - Proceedings, Vol 45, Session 1969-70, p 471-490, March 1970. 14 fig, 18 ref, 1 append.

Descriptors: *Resistance networks, *Aquifers, *Groundwater, *Mathematical (Studies), Models, *Numerical analysis, Deep wells, Cutoff walls, Design.
Identifiers: Multiwell dewatering installation.

The use of the electrical resistance network in analyzing complex unconfined groundwater flow problems was discussed. The first part was concerned with the techniques of representing the aquifer, wells and cut-off walls and also stationary and moving water tables. The resistance network method was described and illustrated by considering a full-time varient solution. The factors affecting a groundwater solution were listed. Mathematical solutions to unconfined well problems were divided into two groups. The first group consisted of formulae which assumed only horizontal flow because the water table is effectively horizontal. In the second type, the flow is not horizontal. Owing to the limitation of mathematical solutions, numerical solutions to groundwater problems were attempted. The resistance network solution can include wells, cut-off walls and any form of non-homogeneous aquifer and was used for a variety of practical engineering problems. The analysis of a multiwell dewatering installation was shown as an example of a quick, more economical technique. The results from many different dewatering systems were summarized and an approximate design method based on the results was proposed. The design method was then tested against a dewatering problem for which a case history was available. The accuracy and implications of the design method were discussed. (Kriss-Cornell)
W70-08849

4C. Effects on Water of Man's Non-Water Activities

ENVIRONMENTAL IMPACT OF THE BIG CYPRESS SWAMP JETPORT.
Department of the Interior, Washington, D.C.

U S Department of the Interior Report, 1969. 153 p, 19 fig, 4 tab.

Descriptors: *Urbanization, *Ecology, *Swamp, *Florida, *Airports, Aquatic environment, Marshes, Drainage systems, Land use, Environmental effects, Habitats, Highway effects, Ecosystems.
Identifiers: Florida jetport, Big Cypress Swamp, Everglades Park.

Development of the proposed Big Cypress Swamp jetport, Florida and attendant facilities will lead to land drainage and development for agriculture, industry, housing, transportation, and services in the Swamp which will destroy the south Florida ecosystem and Everglades National Park. Construction of each training strip will destroy about 400 acres of natural habitat. No significant problems are expected from the limited sewage, industrial wastes or pesticides in the training phase. Air pollutants from engine exhausts will be substantial. There will be frequent high level noise intrusion on the wilderness character of the northern part of Everglades National Park and even more on the Big Cypress and Conservation Area No. 3. A severe bird strike problem may develop within the airport boundaries. With sufficient culverts provided through runways, ramps, roads, and other facilities, interference with overland flow will be negligible. The combination of bird strikes, pest insect problems and incidence of small animals on runways will probably lead to drainage of at least part of the jetport property. Construction and imminent operation of the first training strip have elevated surrounding land prices and sales. Economic and social pressures for further development within and without the port property will mount rapidly. Land development and drainage will be accompanied by increased nutrients in the water, will alter the hydroperiod, and will promote eutrophication. (Lang-USGS)
W70-08596

DETERMINATION OF THE POLLUTIONAL EFFECT OF SURFACE RUNOFF,
Ministry of Land Reclamation and Water Economics, Minsk (USSR). Inst. of Water Problems.
For primary bibliographic entry see Field 05C.
W70-08639

URBANIZATION AND THE WATER BALANCE,
Geological Survey, Washington, D.C. Water Resources Div.
Andrew M. Spieker.
In: Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association, Urbana, Illinois, p 182-187, 1969. 2 fig, 8 ref.

Descriptors: *Urbanization, *Rainfall-runoff relationships, *Water pollution sources, Cities, Silts, Time lag, Sediment load, Erosion, Silting, Water supply, Waste disposal, Withdrawal, Surface-groundwater relationships, Subsidence, Floods, Hydrographs, Peak discharge, Low flow.
Identifiers: Urban hydrology, North America.

Urbanization modifies the hydrologic balance by causing changes in the distribution and quality of water in time and place. The overall quantity of water, however, remains essentially unchanged. In extreme cases, the lack of adequate management measures can result in catastrophic events. Several examples are cited. In 1969 floods in southern California were intensified by uncontrolled urban sprawl in alluvial fans and canyons. Sewering of urbanized areas on Long Island has caused an increase in direct runoff and flood peaks, and a lowering of groundwater levels. Detailed studies of storm runoff in Fairfax County, Virginia, have shown that urbanization in small watersheds increases peak flow by 2 to 3 times, and shortens the lag time by about 8 times. Intensive construction in urbanizing areas can result in sharply increased sediment loads in streams and lakes. Chemical and bacterial quality of water are also affected by urbanization. Studies of Salt Creek, a small stream in suburban Chicago, indicate high coliform and BOD levels at both low and high flows. Coliform counts are greater at high flows, resulting from combined sewer overflows. (See also W70-08597)
W70-08990

PERFORMANCE OF AN ASPHALT TREATED DRAINAGE BLANKET IN A FLEXIBLE PAVEMENT SECTION,
California State Div. of Highways. Materials and Research Dept.
For primary bibliographic entry see Field 04A.
W70-09005

4D. Watershed Protection

AN OPERATIONAL WATERSHED MODEL STEP 1-B: REGULATION OF WATER LEVELS IN THE KISSIMMEE RIVER BASIN,
Central and Southern Florida Flood Control District, West Palm Beach.
Lalit K. Sinha.
Water Resources Bulletin, Vol 6, No 2, p 209-221, March-April 1970. 5 fig, 3 tab, 12 ref.

Descriptors: *Mathematical models, *Simulation analysis, *Watershed management, *Water levels, *Spatial distribution, *Temporal distribution, Gradually varied flow, Spillway gates, Lake stages, Florida.
Identifiers: Mean daily water surface elevation, Kissimmee River Basin.

Step - 1B in the first phase of an 'Operational Watershed Model' recently initiated by the Central and Southern Florida Flood Control District for managing its water resources was to compute water surface elevation, spatially and temporarily, in the Kissimmee River Basin system of reservoirs, channels and spillways. The approach was based upon the principles of gradually varied flow and consisted of two parts. One, a qualitative delineation of the basin into typical systems and two, the development of mathematical models to compute lake stage as a function of storage, and to compute discharge through the control structures as a function of gate opening and differential head across the structures. Their feasibility for application was demonstrated by the simulation of mean daily water surface elevation for a period of two years on the tail side of one typical gated spillway and on the head side of another gated spillway. (Kriss-Cornell)
W70-08858

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

DETERMINING THE DISSOLVED OXYGEN IN SMALL QUANTITIES OF WATER,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
D. A. Jones.
Corrosion, Vol 26, No 7, p 151-154, June 1970. 4 p, 2 fig, 1 tab, 5 ref. AEC Contract No AT (45-1)-1830.

Descriptors: *Sampling, Water analysis, *Dissolved oxygen, Corrosion, Boiler feed water, Corrosion control, Chemical analysis, Analytical techniques.
Identifiers: Dissolved oxygen analysis.

A method is suggested in which water for dissolved oxygen analysis is drawn directly into a small evacuated sampling vessel to preclude contamination from atmospheric oxygen yet not seriously deplete a limited water supply. The indigo-carmine colorimetric method and the polarographic method were modified to determine the dissolved oxygen in a filled sample vessel. (Knapp-USGS)
W70-08594

INSTRUMENTATION IN WATER QUALITY MONITORING AND SAMPLING,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
R. M. Gale.
Proceedings of Canadian Hydrology Symposium No 7, Victoria, British Columbia, scheduled for May 14-15, 1969; held Oct 8-9, 1969, National Research Council of Canada, Subcommittee on Hydrology, p 141-154, Vol 1, 1969. 14 p, 7 ref.

Descriptors: *Water quality, *Monitoring, *Sampling, *Instrumentation, Data processing, Data transmission, Telemetry, Data collections, Water pollution, Water chemistry, Water analysis.
Identifiers: Water quality instrumentation, Canada.

The methods used in Canada for water quality monitoring and water sampling are discussed and the advantages and disadvantages of these methods are pointed out. The factors which govern the need for and the location of water quality instrumentation are discussed, with particular emphasis on economics. Installation methods to meet specific requirements under conditions such as weather and location are described. Methods of recording, transmitting and processing data produced by monitoring equipment are outlined and the usefulness of these data in determining water quality variations, optimum sampling frequencies, and general pollution conditions are briefly discussed. (Knapp-USGS)
W70-08616

THE QUANTITATIVE RELATION OF BACTERIA AND CILIATES TO WATER POLLUTION,
Czechoslovak Academy of Sciences, Prague. Hydrobiological Station.
Vera Straskrabova, and Milos Legner.
In: Advances in Water Pollution Research, Proceedings 4th International Conference on Water Pollution Research, held in Prague, Caechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, p 57-67, 1969. 11 p, 6 fig, 3 tab, 13 ref.

Descriptors: *Biomass, *Bacteria, *Protozoa, *Water pollution, Biochemical oxygen demand, Dissolved oxygen, Reservoirs, Streams, Rivers, Sewage, Foreign research, Bioindicators.
Identifiers: Czechoslovakia.

To study the quantitative relationships between organisms and the organic load in stream self-purification, 195 water samples were analyzed from reservoirs, brooks, rivers and sewage. All the organisms studied showed a direct relationship between their quantity and concentration of decomposable organic substances present. The bacterial numbers to BOD ratio was different in static and flowing waters for colonies on beef-peptone agar, whereas for direct counts on membrane filters no difference between the two types of water bodies was found. Most of the planktonic bacteria in moderately polluted surface waters are unable to grow on agar media. The relationship between the production of ciliates and the bacterial number was different for different species. (Woodard-USGS)
W70-08630

WATER QUALITY PROTECTION PLANS IN RIVER BASINS,
Institute of Hydrotechnical Research, Bucharest (Rumania). Surface Water Lab.
For primary bibliographic entry see Field 05G.
W70-08632

THE PROBLEM OF THE CYTOTOXICITY OF WATER,
Paris Health Lab. (France).
For primary bibliographic entry see Field 05C.
W70-08634

THE PREDICTION OF THE DISTRIBUTION OF DISSOLVED OXYGEN IN RIVERS,
Water Pollution Research Lab., Stevenage (England).
For primary bibliographic entry see Field 05B.
W70-08636

STATISTICAL CHARACTERIZATION OF MIXTURES OF HYDROCARBONS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland); and Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland).
J. Ruchti, and H. R. Krahenbuhl.
Advances in Water Pollution Research, Proceedings, 4th International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, p 205-211, 1969. 7 p, 2 fig, 1 tab, 7 ref.

Descriptors: *Water pollution sources, *Pollutant identification, *Oils, *Oily water, *Gas chromatography, Computers, Data processing, Foreign research, Statistical methods, Analytical techniques.
Identifiers: *Characterization, *Hydrocarbons, *Mixtures.

The possibility of characterizing oils by statistical treatment of their gas chromatographic behavior is discussed. In principal, complex mixtures of hydrocarbons can be characterized and distinguished by the proposed average gas chromatographic retention times. The following oils were used in the experiments: octane fraction, benzine fraction, nonane fraction, terpenaline fraction, decane fraction, petrol special, kerosene fraction, undecane fraction, fuel oil extra light, AVIA fuel oil, BP long-life, BP SAE-30, used oil, and crude oil. Calculations were performed on the Control Data 1604-A computer of the computation center at the Swiss Federal Institute of Technology, Zurich. (Woodard-USGS)
W70-08640

PHYSICAL AND BIOCHEMICAL ASPECTS OF B.O.D. KINETICS,
Karlsruhe Univ. (West Germany). Inst. of Engineering Biology.
Ludwig Hartmann, and Peter Wilderer.
In: Advances in Water Pollution Research, Proceedings 4th International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, p 241-251, 1969. 11 p, 7 fig, 9 ref, 2 append.

Descriptors: *Water pollution effects, *Biochemical oxygen demand, *Kinetics, Laboratory tests, Chemical reactions, Equations, Dissolved oxygen.
Identifiers: BOD Kinetics.

Based on theoretical and literature studies, experiments were made in an attempt to formulate a new mathematical equation for the BOD process. The same substrate concentration was brought into contact with different amounts of adapted activated sludge; thus different load values were obtained. The synthetic sewage consisted of Liebig's meat extract. (Woodard-USGS)
W70-08641

DIGITAL SIMULATION SYSTEM FOR PREDICTION OF WATER QUALITY,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 05B.
W70-08642

SUGGESTED CLASSIFICATION OF WATER QUALITY BASED ON BIOLOGICAL CHARACTERISTICS,
Water Management Center, Erfurt (East Germany).
Wolf von Tumpling.
In: Advances in Water Pollution Research, Proceedings 4th International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, p 279-286, 1969. 8 p, 2 fig, 3 tab, 27 ref.

Descriptors: *Classification, *Water quality, *Biological properties, *Statistical methods, Biochemical oxygen demand, Dissolved oxygen, Foreign research, Water pollution effects, Water utilization.
Identifiers: *Saprobic index, German Democratic Republic.

Water quality ranging from high purity to very highly polluted conditions is classified and related to appropriate water uses, based on statistical investigations of biological state and oxygen balance. Other data show relationships between saprobic index and dissolved oxygen deficit, biological oxygen demand and ammonium ion concentration; between degree of saprobity and dissolved oxygen deficit, biochemical oxygen demand, and ammonium ion concentration; and between the degree of saprobity and the biochemical oxygen demand. (Woodard-USGS)
W70-08643

A RAPID METHOD FOR ORTHOPHOSPHATE ANALYSIS AT HIGH CONCENTRATIONS IN WATER,
National Inst. for Water Research, Pretoria (South Africa).
J. E. Harwood, R. A. van Steenderen, and A. L. Kuhn.
Water Research, Vol 3, p 417-423, 1969. 2 fig, 1 tab, 18 ref.

Descriptors: *Phosphorus, *Analysis, Calibrations, Analytical techniques, Phosphorus compounds.
Identifiers: Orthophosphates, Organic phosphorus, Antimony, Ascorbic acid.

Range of linear portion of calibration curve for determination of orthophosphate by Murphy and Riley (1962) method is increased by using greater quantities of antimony. Antimony as a catalyst was found to be bound in 1:1 ratio with ascorbic acid reduced molybdophosphoric acid complex. Range of phosphorus tested was 10-150 micrograms. Sensitivity was not appreciably increased. Proposed method can be extended to trace quantities by using large aliquots and/or larger cell path length. Interference from condensed phosphates and cyanic phosphate was minimal. Interference from labile phosphorus was significant. (Bannerman-Wisconsin)
W70-08667

COMPUTER MODEL OF CONNECTICUT RIVER POLLUTION,
United Aircraft Corp., East Hartford, Conn. Research Labs.
For primary bibliographic entry see Field 05G.
W70-08843

SEPARATION OF PHENOLS IN WATERS BY THIN LAYER CHROMATOGRAPHY,
National Research Centre, Cairo (Egypt). Water Pollution Dept.
For primary bibliographic entry see Field 05F.
W70-08901

AN EVALUATION OF THE STANDARD BIOCHEMICAL AND ELEVATED TEMPERATURE TESTS FOR DIFFERENTIATING FAECAL AND NON-FAECAL COLIFORMS,
Central Public Health Engineering Research Inst., Nagpur (India).
For primary bibliographic entry see Field 05D.
W70-08913

THE APPLICATION OF PHASE SELECTIVE ALTERNATING CURRENT POLAROGRAPHY TO THE ANALYSIS OF HEAVY METALS IN WATER,
Georgia Inst. of Tech., Atlanta. Environmental Resources Center.
Peter E. Sturrock, and Robert L. Poole, Jr.
Available from the Clearinghouse as PB-193 412, $3.00 in paper copy, $0.65 in microfiche. Completion Report, June 1970. 55 p, 4 fig, 21 ref. OWRR Project A-020-GA (1).

Descriptors: *Polarographic analysis, *Heavy metals, *Electrolysis, *Aqueous solutions, *Elec-

troanalytical techniques, Electrolytes, Ions, Water pollution, Water treatment.
Identifiers: *Alternating current polarography, *Square-wave polarography.

The suitability was investigated of phase selective alternating current polarography and square-wave polarography for analyzing water for low concentrations of heavy metal ions. The application of phase selective alternating current polarography for analysis of heavy metals in water is examined in detail. Use of square-wave polarography is examined to a lesser degree. A variety of heavy metal ions are examined and optimum conditions for analyzing the individual ions are documented. Conditions are given for analyzing various multicomponent mixtures. Problems due to interferences from surfactants on ac polarographic techniques and methods for eliminating interferences are set out. Both selective ac and square-wave polarography were suitable for water analysis. Square-wave polarography was the more sensitive. The selective ac technique was very suitable for analysis of multicomponent systems. (Conway-Georgia)
W70-08986

5B. Sources of Pollution

THE QUANTITATIVE RELATION OF BACTERIA AND CILIATES TO WATER POLLUTION,
Czechoslovak Academy of Sciences, Prague. Hydrobiological Station.
For primary bibliographic entry see Field 05A.
W70-08630

AN APPROACH TO DETERMINE THE MINIMUM ALLOWABLE FLOW IN THE 'TISZA' RIVER FROM THE VIEWPOINT OF WATER QUALITY,
Research Inst. for Water Resources Development, Budapest (Hungary).
Bela Hock.
In: Advances in Water Pollution Research, Proceedings 4th International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, p 75-86, 1969. 12 p, 4 fig, 3 tab, 10 ref.

Descriptors: *Forecasting, *Water quality, *Reservoirs, *Irrigation water, *Water quality control, Water resources, Streamflow, Biochemical oxygen demand, River forecasting, River regulation, Equations, Foreign research.
Identifiers: *Tisza River (Hungary).

Existing reservoirs and future construction of water storage systems on the Tisza River in Hungary for irrigation purposes will fundamentally change the water regime of the river and create problems regarding water pollution management. To solve these problems, forecasting the future water quality is necessary. The correlation between the different components of water quality and the flow are characterized by equations. By using the appropriate corrections, the equations can be used for forecasting water quality of the river in 1980. The minimum allowable flow from the reservoir is based on a maximum concentration of 10 mg/l permanganate biochemical oxygen demand value. (Woodard-USGS)
W70-08633

WATER RESOURCES STUDIES IN THE ARA VALLEY,
Tokyo Univ. (Japan). Dept. of Urban and Sanitary Engineering.
For primary bibliographic entry see Field 05B.
W70-08635

WATER RESOURCES STUDIES IN THE ARA VALLEY,
Tokyo Univ. (Japan). Dept. of Urban and Sanitary Engineering.
A. Sugiki, T. Matsuo, and K. Tanaka.
In: Advances in Water Pollution Research, Proceedings 4th International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, p 107-119, 1969. 13 p, 5 fig, 8 tab, 5 ref, 2 append.

Descriptors: *Water resources development, *Planning, *Water pollution control, *River basins, *Urbanization, Water conservation, Water demand, Regulation, Equations, Foreign research, Systems analysis, Zoning.
Identifiers: *Industrailization, Ara Valley, Tokyo (Japan).

Water pollution control of rivers flowing through metropolitan areas requires particular study in Japan because of the many problems created by the rapid pace of urbanization and industrialization. In 1985 about 80% of Japan's population will dwell in urban areas and industrial production will be 7-8 times greater than at present. With these drastic developments it is necessary to determine how rivers may be maintained free of pollution. A plan is proposed for water conservation in Japan, illustrated by the Ara Valley Area, a typical polluted river in the Tokyo Metropolitan Area, as a case study. A general description is given of the present and future conditions of the Ara River Basin. Future water demands and pollution loads are predicted. Regulation of industrial development is proposed as a regional planning approach to overcome an inevitable water quality deterioration, and the effects of regulation of industrial development are considered. A systems analytical method is applied to obtain an economically and technically optimum water conservation plan for the proposed basin. (Woodard-USGS)
W70-08635

THE PREDICTION OF THE DISTRIBUTION OF DISSOLVED OXYGEN IN RIVERS,
Water Pollution Research Lab., Stevenage (England).
M. Owens, G. Knowles, and Anne Clark.
In: Advances in Water Pollution Research, Proceedings 4th International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, p 125-137, 1969. 13 p, 7 fig, 2 tab, 19 ref.

Descriptors: *Water quality, *Forecasting, *Dissolved oxygen, *Rivers, Velocity, Equations, Light intensity, Temperature, Aquatic weeds, Photosynthesis, Foreign research.
Identifiers: River Ivel (England).

Equations are formulated for predicting the widely varying concentrations of dissolved oxygen that occur in a non-polluted reach of a shallow river (River Ivel, in England) from such data as light intensity, temperature, amount of aquatic weed present, initial oxygen content, and photosynthetic and respiratory rates of aquatic plants and benthic material. (Woodard-USGS)
W70-08636

STATISTICAL CHARACTERIZATION OF MIXTURES OF HYDROCARBONS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland); and Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland).
For primary bibliographic entry see Field 05A.
W70-08640

PHYSICAL AND BIOCHEMICAL ASPECTS OF B.O.D. KINETICS,
Karlsruhe Univ. (West Germany). Inst. of Engineering Biology.
For primary bibliographic entry see Field 05A.
W70-08641

DIGITAL SIMULATION SYSTEM FOR PREDICTION OF WATER QUALITY,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
R. T. Jaske.
In: Advances in Water Pollution Research, Proceedings 4th International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, p 261-271, 1969. 11 p, 6 fig, 2 tab, 10 ref. AEC Contract AT (45-1) 1830.

Descriptors: *Forecasting, *Water quality, *Digital computers, *Systems analysis, *Columbia River, Equations, Meteorological data, Streamflow, Channel morphology, Biochemical oxygen demand, Dissolved oxygen, Density currents.
Identifiers: *Time-of-travel (Streams).

Water releases from Lake Roosevelt and other impoundments in the Columbia River between the Grand Coulee Dam and the Hanford plant have increased the travel time, introduced complicating density currents, and generally made a digital simulation system necessary to take advantage of the use of a great number of separate coefficients. Statistical studies are not necessary for each studied reach, and readily available dimensional, flow and weather data may be used. The basic system is readily adapted to the addition or deletion of subprograms without requiring the necessity to remeasure the overall coefficients. Further, the system is capable of adjusting, variables stochastically in response to primary inputs. The system when tested against a set of real data is capable of synthesizing to within 10% on short runs and less than 10% of records on longer runs. Temperatures have been consistently predicted to an accuracy of 0.25 deg C over a yearly period between regional points 200 to 500 km apart using a maximum of three weather station inputs. (Woodard-USGS)
W70-08642

INVESTIGATIONS OF THE RESIDUES OF CHLORINATED INSECTICIDES IN GROUNDWATER (In Italian),
Florence Univ. (Italy). Inst. of Hygiene.
C. Grasso.
Bollettino della Societa Italiana di Biologia Sperimentale, Vol 44, No 20, p 1701-1702, 1968.

Descriptors: *Groundwater, *Chlorinated hydrocarbon pesticide, Osmosis, Insecticides, Water purification, Soils.
Identifiers: Italy, Natural filtration.

Studies were made to determine whether insecticide residues are present in subterranean waters or whether they are eliminated by natural filtration; and whether substrates retain greater amounts of chlorinated insecticides than eliminated by artificial purification. Sampling included oligotrophic, mesotrophic and eutrophic waters and springs of different geophysical characteristics and in localities of diversified agricultural exploitation. Sampling was accomplished by gas chromatographic method with an electron capture detector (strontium-90). No chromotograms evidenced chlorinated insecticidal residues. Natural filtration adsorbs undesirable chemicals which have a prolonged life in soils, water, food, and animal organs. (Auen-Wisconsin)
W70-08659

RESEARCH OF THE RESIDUES OF CHLORINATED INSECTICIDES IN THE SURFACE WATER USED FOR DRINKING (In Italian),
Florence Univ. (Italy). Inst. of Hygiene.
C. Grasso.
Bollettino della Societa Italiana di Biologia Sperimentale, Vol 44, No 20, p 1702-1703, 1968.

Descriptors: *Insecticides, *Potable water, *Chlorinated hydrocarbon pesticides, Water pollution effects, Water pollution sources, Chlorination, Toxicity, Surface waters, Water purification.
Identifiers: Italy, Arno River, Bientino River.

Insecticide usage, initially in agriculture, has extended its scope to the realm of hygiene, sanitation, and disease prevention. The residual toxicity was researched in potable waters of the Arno and Bientino Rivers (Italy) as well as the efficacy of purification plants located at Anconella (Florence) and at Stagno (Liverno). Sampling was concentrated near the purification plants, analyses detecting the following chlorinated insecticides (listed in descending order of ppm): lindane, heptachlor, epoxide of heptachlor, aldrin, dieldrin, DDE, DDD, and pp'DDT. No organophosphate insecticides were detected and it was surmised that they were degraded by the alkaline water of the rivers (pH 7.8-8.3). Unpurified water contained relatively low insecticide concentrations, ostensibly diminished by sedimentation, flocculation, and filtration. Chlorination failed to produce detectable results. Hypothetical conclusion is that insecticide concentrations are decreased by physico-mechanical processes, with no evident effect exerted by chlorination at the rate of 1 milligram/liter. (Auen-Wisconsin)
W70-08660

NITRATE CONTENT OF THE UPPER RIO GRANDE AS INFLUENCED BY NITROGEN FERTILIZATION OF ADJACENT IRRIGATED LANDS,
Agricultural Research Service, Riverside, Calif. Salinity Lab.; Bureau of Reclamation, El Paso, Tex.; and International Boundary and Water Commission, El Paso, Tex.
C. A. Bower, and L. V. Wilcox.
Soil Science Society of America Proceedings, Vol 33, No 6, 1969. 1 fig, 3 tab, 11 ref.

Descriptors: *Nitrates, *Nitrogen, *Rio Grande, *Subsurface drainage, Drainage water, Salinity, Fertilizers, Groundwater, Irrigation effects, Leaching, Denitrification, River flow, Water pollution sources.
Identifiers: Upper Rio Grande, Salt balance.

An analysis of salt balance conditions on three irrigated areas along Upper Rio Grande between 1934-1963 is summarized. Nitrate content of water before irrigation and of drainage water was of specific interest. During 30-year period amount of nitrogen fertilizer applied increased by 35- to 100-fold. Decreasing annual river flows were major cause of significant increase of average annual nitrate load of river between 1954-1963 period. Increased use of nitrogen fertilizer in three areas has not increased overall nitrate nitrogen in Upper Rio Grande. El Paso Valley has slightly increased river nitrate nitrogen due to very low flows and sewage effluent. Insignificant contribution of nitrate nitrogen load to river from Rincon and Mesilla valleys was result of denitrification of leached nitrate nitrogen under anaerobic conditions in water saturated soil. (Bannerman-Wisconsin)
W70-08662

2,4-D CONTAMINATION AND PERSISTENCE IN IRRIGATION WATER,
Bureau of Reclamation, Denver, Colo.
T. R. Bartley, and A. R. Hattrup.
Paper at 23rd Annual Meeting of Western Society of Weed Scientists, Sacramento, Calif, Mar 1970. 32 p, 13 fig, 1 tab.

Descriptors: *Irrigation canals, Irrigation ditches, Spraying, *2-4-D, *Irrigation water, Water quality, Water analysis, Water sampling, Weeds, Herbicides, *Pesticide residues, Pesticides, Tolerances (Plant), *Weed control, Contamination, Water pollution sources, Water pollution.
Identifiers: Columbia Basin Project, Wash.

Concentration of 2,4-D in irrigation water and the rate of decline as the water moved downstream were studied by analyzing water samples collected from 18 irrigation canals on the Columbia Basin Project, Wash. The ditchbanks along these canals received routine applications of 2,4-D for control of weeds. Maximum concentration of 2,4-D found in each canal ranged as follows: 6 to 28 ppb in 9 canals, 38 to 100 ppb in 8 canals, and 214 ppb in one canal. In the 9 canals having the very low concentrations, the decline of the peak level of 2,4-D was very gradual as the water moved downstream. The peak levels in the canals with the higher concentrations showed some rises and declines at sampling stations below the first sampling site. This study indicates that the dimethylamine formulation of 2,4-D is persistent for several miles in irrigation water without much decline in concentration. In most cases, those canals carrying the greater quantity of water (74 to 840 cfs) contained the lowest levels of 2,4-D, and the higher levels occurred in flows ranging from 6.8 to 56 cfs. Waterflow, application rate, and herbicide spray overlap onto the water surface are major factors influencing herbicide concentration in irrigation water. (USBR)
W70-08681

THE BOD OF TEXTILE CHEMICALS,
American Association of Textile Chemist and Colorists, Durham, N.C.
William Stafford, and Harold J. Northup.
American Dyestuff Reporter, Vol. 44, No. 11, p 355-359, May 23, 1955. 1 tab, 1 fig, 8 ref.

Descriptors: *Biochemical oxygen demand, Water pollution, Rhode Island, Detergents.
Identifiers: *Textile mill wastes, Textile chemicals.

A study was made by the Rhode Island Sectional Stream Pollution Committee to make available BOD data on textile chemicals and dyes. The 5-day BOD's of 154 chemicals are given. Long-term BOD should be determined on chemicals with low 5-day BOD. By using low-BOD chemicals whenever possible, stream pollution is greatly reduced. However, some chemicals with a low BOD have other objectionable qualitites. High BOD per se does not eliminate a chemical from use as cost and efficiency must be considered. Large quantitites of low-BOD detergents may result in commulative detergent pollution. (Lonon-North Carolina State)
W70-08735

DETERGENTS - TODAY AND TOMORROW,
Gardinol Chemical Co.
Peter H. A. Strasser.
Textile Journal of Australia, Vol 40, No 5, p 12-13, 38, 41-43, May, 1965. 6 fig.

Descriptors: *Biodegradation, *Detergents, Sewage treatment, Water pollution.
Identifiers: *Textile mill wastes, Wool, Wool scouring.

The problem of biodegradability has stimulated a large amount of research in the detergent industry. The detergents now used are degraded about 60 percent in 24 hours in a sewage treatment plant. However, some authorities feel degradability should be at least 80 percent in 24 hours. As most of Australia's large centers of population have water sources independent of long rivers, the detergent-pollution problem is not very great there. The history of and research in detergents, particularly as related to wool scouring, is discussed at some length. (Lonon-North Carolina State)
W70-08737

BIODEGRADABLE DETERGENTS - SOFT DETERGENTS,
Hart Chemical Ltd., Guelph (Ontario).
H. Zimmerman.
Canadian Textile Journal, Vol. 82, p 43-45, January 22, 1965. 3 fig.

Descriptors: *Alkylbenzene sulfonates, *Biodegradation, Detergents, Water pollution, Waste waters, Biochemical oxygen demand, Fish, Algae, Foaming, Sewage treatment.
Identifiers: *Textile mill wastes, Alfol alcohols.

The alkyl aryl sulphonates are non-biodegradable, whereas soaps, the fatty alcohol sulphates and other fat based detergents, are readily biodegradable. These biodegradable synthetic detergents are available, but their use does not solve the over-all problems of water pollution. Nearly all waste waters from textile operations have a high BOD which affects fish life. The degradation of an alkyl aryl sulphonate in a sewage treatment process is only about 50 percent, and in river water is only about 75 percent in 30 days. The chemistry of alkyl benzene sulphonates (ABS) and the alfol alcohol process is discussed. The major nuisances from ABS residues are foaming and algal growths. There is little evidence that ABS residues are toxic to humans or fish, but the foaming adversely affects sewage treatment. (Lonon-North CarolinaState)
W70-08740

AIR AND WATER POLLUTION: WHAT TO DO WHILE WAITING FOR WASHINGTON,
For primary bibliographic entry see Field 06E.
W70-08802

EFFLUENT CHARGES AND THE INDUSTRIAL WATER POLLUTION PROBLEM,
Albert E. Grady.
New Eng L Rev, Vol 5, p 61-27, 1969. 34 ref.

Descriptors: *Water pollution, *Pollution abatement, *Industrial wastes, *Water pollution control, Water pollution treatment, Effluents, Riparian rights, Public health, Taxes, Costs, Operating costs, Industrial wastes, Water quality, Standards, Water Quality Act, Legislation, State governments, Federal government, Legal aspects, Political aspects, Administrative agencies, Industries.
Identifiers: *Effluent charges.

Pollution has become an extremely serious and perplexing problem in the United States. The major contributors to pollution are government and industry. As industry established itself in the last century, pollution was actually encouraged by the creation of a right to reasonable pollution under riparian law and by the balancing-of-equities doctrine. Courts can no longer act as the vehicle for controlling pollution; legislative action is the only feasible alternative. The basic question to be answered is who will pay for pollution abatement--taxpayers or industry. It is apparent that both will have to contribute to the cost of abatement. Tax incentives appeal to industry and can provide a method of inducing installation of abatement facilities. However, there is no way to insure the quality of the investment for the efficiency of its operations. A highly recommended method is for states to set stream quality standards and to place effluent charges upon any industrial wastes which exceed the predetermined permissible levels. All industries will thereby be made answerable for their pollution and will be treated equally and fairly. (Hubener-Florida)
W70-08803

THE USE OF DIGITAL SYSTEMS MODELING IN THE EVALUATION OF REGIONAL WATER QUALITY INVOLVING SINGLE OR MULTIPLE RELEASES,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
R. T. Jaske.
Battelle Memorial Institute, BNWL-SA-1372, August, 1967. 10 fig, 1 tab, 9 ref.

Descriptors: *Model studies, *Turbulent flow, *Computer programs, Theoretical analysis, Water temperature, On-site data collections, Mathematical models, Channel flow, Grand Coulee dam, Density currents, Columbia River, Weather data.
Identifiers: *Transport model, Bowen ratio, Interfacial mass exchange.

In 1963, a digital simulation model was started with the objective of modeling various streams. The major emphasis on the improved transport model was for it to be general enough for application to any turbulent stream. As a result, the development of a digital simulation system based on theoretical

channel flow has been successfully accomplished and used in a variety of cases involving widely divergent input variables. For example, river temperatures in existing systems have been successfully modeled to within 0.25C over a six month period. Moreover, the resulting transport model is suitable for preliminary studies of effluent dispersion for emergency planning or in cases where little or no actual field data exist. Even the Bowen ratio can be continuously varied and the results compared with field data as a means of determining the validity of related concepts. Comparison can readily be made among comparative mathematical models governing varying interfacial mass exchange expressions as a means of determining the relative error introduced or the degree of accuracy required for individual parametric measurements. A hypothetical example is shown for the Illinois River. (Osborne-Vanderbilt)
W70-08828

THERMAL LOADING IN DUNKIRK HARBOR,
State Univ. Coll., Fredonia, N.Y.
Ruth E. Braun, and John A. Jones.
Lake Erie Environmental Studies, Technical Report No. 5, April 1970. 12 p, 6 fig.

Descriptors: *Thermal pollution, *Water temperature, *Heat, Water circulation, Powerplants, Warm-water fishing, Seasonal, Surfaces, Volume, Harbors, Lake Erie, Winds, Eddies, Isotherms, Conductivity, Reservoir evaporation.
Identifiers: *Temperature anomalies, Thermistor, Relative humidity.

Thermal loading due to warmed effluents from a power plant located on Dunkirk harbor has been investigated over a 14-month period. Temperature anomalies of more than 3C were found to exist in the harbor year-round. Greatest anomalies occurred in March, smallest anomalies in April. The harbor basin was noted to be capable of dissipating the heat added by the power plant. Little effect could be found outside the confines of the harbor. No serious detrimental effects due to thermal loading have been demonstrated. As far as the residents of Dunkirk are concerned, the heat which the power plant releases is more beneficial than harmful. Fishing is good year-round and boats can remain in the water over the winter. Since the harbor basin is capable of dissipating the added heat under present conditions, the ratio of heat added to the surface area or volume of the harbor is considered favorable. Any project which might change the size of circulation pattern in the basin should be carefully considered in light of the effects it might have on the characteristics of thermal dissipation of the harbor. (Osborne-Vanderbilt)
W70-08838

A WATER QUALITY MODEL OF CHLORIDES IN GREAT LAKES,
Manhattan Coll., Bronx, N.Y. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02K.
W70-08931

MODEL FOR CAPTURE OF RADIOACTIVITY BY PRECIPITATION,
Institute of Experimental Meteorology, Obninsk (USSR).
For primary bibliographic entry see Field 02B.
W70-08941

DISPOSAL OF SOLID AND SEMI-SOLID TOXIC WASTES,
Hertfordshire County Council (England).
J. L. Stringer.
Water Pollution Control, Vol 69, No 3, p 321-333, 1970. 3 ref.

Descriptors: *Disposal, *Industrial wastes, *Solid wastes, *Toxicity, Liquid wastes.

A discussion is given of refuse disposal methods in Hertfordshire, an area rich in sand and gravel operations. Methods of disposal include: pretreatment, dumping, incineration, salvage, and sea disposal. Many conflicting interests are involved in the disposal of toxic wastes, including: industry, waste removal contractors, river authorities and water undertakings, sewerage authorities, and public health and planning interests. Most disposal problems have arisen from the handling and dumping of putrescible materials. Depending on the geological conditions and the nearness of wells, the water interests often require protection of the underlying chalk with varying thicknesses of inert material. Risks from dumping of toxic materials vary with the location of the site in relation to wells, the nature of the underground strata and the character of the material. Natural or physical processes reduce the risk, such as when an acid waste is disposed of on chalk. Ion exchange operates in some subsoils, notably clay, while bacteria break down complex molecules and change the chemical properties of some substances. (Aguirre-Texas)
W70-08956

PHYSIOGRAPHY-LAND USE INTERACTIONS IN WATERSHED MANAGEMENT,
British Columbia Univ., Vancouver. Dept. of Forestry.
H. Olav Slaymaker, and Walter W. Jeffrey.
In: Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association, Urbana, Illinois, p 170-181, 1969. 60 ref.

Descriptors: *Geomorphology, *Land management, *Water yield improvement, *Water quality control, Land use, Topography, Drainage patterns (Geologic), Sediment yield, Overland flow, Watershed management, Erosion, Infiltration, Forest management.
Identifiers: Physiography management.

A distinctive characteristic of some physiographic factors and all land use practices which influence hydrologic response is that they can be manipulated over relatively short time periods. Moreover, physiographic and land use parameters interact so as to produce distinctive hydrologic responses. Those physiographic parameters which cannot be manipulated over the short time period are also of interest insofar as they represent the end-product of long-continued operation of physiography-land use interactions. Length of overland flow, drainage density and hydraulic geometry are variables which can be manipulated; relief ratio, maximum valley side slope and drainage basin area are examples of significant geomorphic parameters which are effectively impossible to manipulate. The parts played by surface resistance to erosion and infiltration capacity in a variety of physiography-land use situations are considered. (See also W70-08597)
W70-08989

5C. Effects of Pollution

ADVANCES IN WATER POLLUTION RESEARCH.
For primary bibliographic entry see Field 05G.
W70-08627

THE PROBLEM OF THE CYTOTOXICITY OF WATER,
Paris Health Lab. (France).
L. Coin, C. Hannoun, and J. C. Trimoreau.
In: Advances in Water Pollution Research, Proceeding 4th International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, p 95-101, 1969. 7 p, 2 fig, 3 tab.

Descriptors: *Water pollution effects, *Cytological studies, *Viruses, Laboratory tests, Surface waters, Groundwater, Effluents, Foreign research.
Identifiers: *Phenol index, *Inhibitory minim dose, Paris (France).

In the course of attempts to isolate viruses syste matically from water, secondary toxic phenomen were observed showing that water can manifes certain inhibitory properties with regard to the tes cells cultured for virological practice. After nu merous trials with water of different natures com ing from different areas, the following was deter mined: a phenol index, the value of which approxi mates that of the taste thresholds; and a minimal in hibitory dose for a given cellular population which leads to characterization of the specific features o the organic matter of the water sample. Thes determinations may be considered for inclusion with tests designed to expalin the secondary toxic phenomena. (Woodard-USGS)
W70-08634

FACTORS INFLUENCING PHOSPHATE USE BY ALGAE,
Minnesota Univ., Minneapolis. Limnological Research Center.
Joseph Shapiro, William Chamberlain, and Judith Barrett.
Partially supported by FWQA research grant. In: Advances in Water Pollution Research, Proceeding 4th International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, p 149-160, 1969. 12 p, 10 fig, 3 tab, 13 ref.

Descriptors: *Eutrophication, *Lakes, *Algae, *Growth rates, *Phosphates, Laboratory tests, Minnesota, Nutrients, Water pollution effects.
Identifiers: *Microcystis aeruginosa, *Lake waters.

Microcystis aeruginosa from lakes in Minnesota, was used to show the relationships of phosphorus to algae growth in natural water systems. The rapid rate of absorption of phosphate by algae suspended in lake water is largely due to the inorganic salts of the water and not to an organic factor. (Woodard-USGS)
W70-08637

AVOIDANCE REACTIONS OF SALMONID FISH TO REPRESENTATIVE POLLUTANTS,
Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station.
John B. Sprague, and Donald E. Drury.
In: Advances in Water Pollution Research, Proceedings 4th International Conference of Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, p 169-179, 1969. 11 p, 5 fig, 22 ref.

Descriptors: *Fish, *Water pollution effects, *Pollutants, *Laboratory tests, Atlantic salmon, Rainbow trout, Detergents, Phenols, Chlorine, Pulp wastes, Foreign research.
Identifiers: *Avoidance reactions, Canada.

Studies to determine whether there is a general pattern of spontaneous avoidance reactions by fish to pollutants are described. The laboratory findings are related to field situations to predict behavior of fish if their natural habitat were affected by these pollutants. Rainbow trout and Atlantic salmon were subjected to clean water and to various sublethal concentrations of ABS detergent, phenol, chlorine and pulp mill effluent. Graphs show the percent of time the fish avoided or preferred solutions of clean water and different concentrations of the pollutants. (Woodard-USGS)
W70-08638

DETERMINATION OF THE POLLUTIONAL EFFECT OF SURFACE RUNOFF,
Ministry of Land Reclamation and Water Economics, Minsk (USSR). Inst. of Water Problems.
N. A. Pravoshinsky, and P. D. Gatillo.

In: Advances in Water Pollution Research, Proceedings 4th International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, p 187-195, 1969. 9 p, 3 fig, 1 tab, 27 ref.

Descriptors: *Water pollution sources, *Cities, *Storm runoff, *Surface runoff, *Urbanization, Water pollution effects, Biochemical oxygen demand, Dissolved solids, Bacteria, Oil wastes, Foreign research.
Identifiers: *USSR, Minsk.

Pollution by urban surface runoff depends on the intensity of movement of street traffic and use by pedestrians, type of cover of catchment, duration and intensity of rain, standards of water discharge of watering and washing, the amount of dust deposition, the elevation of the catchment water basin, duration of preceding dry weather period, quality and technology of town cleaning, and the means of dust control. Data were compiled from samples collected in the well-built-up districts of Minsk, USSR remote from big industrial interprises and Soligorsk, a rapidly developing town. The value of 5-day BOD was used as a primary index of runoff pollution. In addition, the concentrations of suspended solids, chlorides, oil-products, and bacterial pollution were determined. (Woodard-USGS)
W70-08639

THE INFLUENCE OF SUSPENDED SOLIDS ON THE RATE OF OXYGEN TRANSFER IN AQUEOUS SOLUTIONS,
Technische Hogeschool, Delft (Netherlands). Dept. of Sanitary Engineering.
G. T. M. Van der Kroon.
In: Advances in Water Pollution Research, Proceedings 4th International Conference on Water Pollution Research, held in Prague, Czechoslovakia, Apr 21-25, 1969: London, Pergamon Press, Ltd, p 219-229, 1969. 11 p, 11 ref, append.

Descriptors: *Dissolved oxygen, *Oxygenation, *Suspension, *Aqueous solutions, Suspended load, Oxygen, Water pollution, Test procedures, Laboratory equipment, Equations, Reaeration, Oxygen demand, Water pollution effects.
Identifiers: Oxygen transfer.

An experimental study was made of the rate of oxygen transfer in artificial mixed liquor samples from a bench scale pilot plant, as well as in suspensions of aluminium hydroxide. Oxygen, absorbed from dispersed air, was continuously replenished by injection of pure oxygen gas into the measuring system. Oxygen sensors were used to determine D. O. -contents of the liquid phase and partial oxygen pressures in the gaseous phase. Because research was primarily on the role of flocculant particles, different operating conditions including rate of gas flow, size of the dispersion device and temperature were held constant. The drop of the oxygen saturation value in a mixed liquor and a suspension of aluminium hydroxide is less than 5%. The rate of oxygen transfer in both suspensions depends upon the concentration of the suspended solids, and decreases when the suspended solids concentration increases. The rate of drop appears to depend on the quality of the suspended flocs. The rate of oxygen transfer in a mixed liquor is independent of the rate of respiration. (Woodard-USGS)
W70-08645

PRELIMINARY OBSERVATIONS ON RESPONSE OF YOUNG ONES OF CHINESE CARPS TO VARIOUS PHYSICO-CHEMICAL FACTORS OF WATER,
Fisheries Research Station, Cuttack (India).
S. B. Singh, S. C. Banerjee, and P. C. Chakrabarti.
Proceedings of the National Academy of Sciences, India, Vol 37 (B), No 111, p 320-324, 1967. 1 tab, 4 ref.

Descriptors: *Carp, Bioassay, *Fish stocking, Fish management, Fish establishment, *Fish behavior, Fish physiology, Water temperature, Mortality, Fishkill, *Water quality, Salinity, Turbidity, Hydrogen ion concentration, Laboratory experiments, Dissolved oxygen, Alkalinity, Ammonia, Sulfides, Water chemistry.
Identifiers: India, *Chinese grass carp, *Silver carp, *Tolerance.

Chinese grass carp and silver carp are being introduced into various parts of India. Laboratory experiments were conducted to study the response and reaction of the young chinese and silver carps to wide fluctuations in water temperature, turbidity, pH, dissolved oxygen, total alkalinity, salinity, free ammonia, chlorine, and sulfide which may occur in the different habitats where the fish were introduced. Tolerance limits for both carp species to the water quality parameters are given. The authors concluded that the grass carp were able to withstand slightly greater fluctuations than were the silver carp. (Sjolseth-Washington)
W70-08646

COHO SALMON MORTALITY AND DDT IN LAKE MICHIGAN,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
Howard E. Johnson, and Charles Pecor.
Thirty-Fourth North American Wildlife Conference Transactions, p 159-166, 1969. 2 tab, 19 ref. FWPCA Training Grant 5T1-WP-109.

Descriptors: *DDT, Chlorinated hydrocarbon pesticides, Pesticide toxicity, Pesticide residues, *Mortality, *Lake Michigan, Eggs, Lake Superior.
Identifiers: *Coho salmon, DDD, DDE, *Fry mortality.

Investigations were initiated in 1967 to identify and quantity pesticide residues in coho salmon eggs in Lake Michigan and to determine their effects on the hatching fry. DDT concentrations in Lake Michigan coho salmon eggs were three to five times higher than in those from Lake Superior and approximately 60 times higher than in eggs from Oregon. A mortality syndrome, characterized by an abrupt appearance of symptoms during the last stage of yolk sac absorption, was observed in all groups from Lake Michigan. No evidence of the symptoms was observed in Lake Superior and Oregon groups. Higher residues in the eggs of Lake Michigan salmon were, in general, associated with higher mortalities of the fry. DDT concentrations in the last fractions of yolk present in the gut when symptoms first appeared were 6 to 12 times higher than in the body tissues. The absorption of relatively high concentrations of DDT from the gut is suggested as an explanation for the mortality of the coho salmon fry. (Sjolseth-Washington)
W70-08647

EXPERIMENTAL USE OF CHLORDANE IN FISHERY MANAGEMENT,
Bihar Univ., Buzaffarpur (India). Dept. of Zoology.
S. K. Konar.
The Progressive Fish-Culturist, Vol 30, No 2, p 96-99, 1968. 5 ref, 3 tab.

Descriptors: *Fish management, Fish control agents, Fish toxins, Pesticide toxicity, Chlorinated hydrocarbon pesticides, Aquatic insects, Catfishes, *Bioassays, *Lethal limit, Daphnia, Fish food organisms, Fish behavior, Phytoplankton, Zooplankton, Fish physiology, Resistance.
Identifiers: *Chlordane, Labeo rohita, Residual toxicity.

Chlordane is highly toxic but not selective to fish and insects. The LD (0), LD (50), and LD (100) of chlordane to 9 species of freshwater fish and to 9 species of aquatic insects are given. Aquatic insects were more resistant than the fish. Generally, the fishes seemed to be more susceptible to the chlordane than most of the zooplankters. The prolonged residual toxicity of chlordane makes it unsuitable for fishery management. The author feels that on the basis of the present results, that chlordane should not be used in pest-control operations in fields adjacent to fishery reservoirs. (Sjolseth-Washington)
W70-08648

DDVP AS A SELECTIVE TOXICANT FOR THE CONTROL OF FISHES AND INSECTS,
Bihar Univ., Buzaffarpur (India). Dept. of Zoology.
U. S. Srivastava, and S. K. Konar.
The Progressive Fish-Culturist, Vol 28, No 4, p 235-238, 1966. 4 ref, 3 tab.

Descriptors: Carp, Pesticide toxicity, *Bioassay, Mortality, Fishkill, Aquatic insects, Lethal limit, Resistance, Fish management, *Fish control agents, Eels, Fish toxins, Predation, Fish farming, Insect control.
Identifiers: *DDVP, *Selective toxicant, *Residual toxicity.

The nonpersistent insecticide DDVP is a selective toxicant that shows promise as a control for predaceous insects and fishes and for competitor fishes in pond culture of carp, Labeo rohita, in India. The authors find DDVP toxic to fish; but the lethal doses for all the 11 fish species tested are much higher than the lethal doses for insects (6 species tested). The residual toxicity of 20 ppm DDVP is about 3 weeks at a temperature range of 44 deg to 77 deg F without the use of any detoxifying substance. This seems to be much shorter than the residual toxicity of most other chemicals tried. (Sjolseth-Washington)
W70-08649

TETRACHLORO-o-BENZOQUINONE AS A COMPONENT IN BLEACHED KRAFT CHLORINATION EFFLUENT TOXIC TO YOUNG SALMON,
Ontario Research Foundation, Toronto; and Fraser Companies Ltd., Edmundston (New Brunswick).
B. S. Das, S. G. Reid, J. L. Betts, and K. Patrick.
J Fish Res Bd Canada, Vol 26, p 3055-3067, 1969. 2 tab, 2 fig, 19 ref.

Descriptors: *Atlantic salmon, *Bioassay, *Pulp wastes, Stability, Water pollution effects, *Toxicity, Fish toxins, Waste identification, Analytical techniques, Mortality, Chemical analysis.
Identifiers: *Tetrachloro-benzoquinone, *Bleached Kraft effluent, Tetrachlorocatechol.

Evidence is given that tetrachloro-benzoquinone is involved in the toxicity of bleached kraft chlorination effluent (BKCE) to young Atlantic salmon, Salmo salar. The main experimental support was isolation of tetrachlorocatechol from whole BKCE and from a BKCE fraction toxic to salmon, after reduction of both with sodium borohydride. Tetrachloro-o-benzoquinone was shown to be toxic to salmon at low concentrations. Instability of the toxic component in BKCE and substantial loss of toxicity upon treatment of BKCE with sulfur dioxide agreed with the properties of tetrachloro-o-benzoquinone in water solution. (Sjolseth-Washington)
W70-08650

HEAT TOLERANCE OF ALBINO VS. NORMAL CHANNEL CATFISH ICTALURUS PUNCTATUS,
Louisiana State Univ., Baton Rouge. Dept. of Forestry and Wildlife Management.
Kenneth O. Allen.
Proceedings of the 22nd Annual Conference of the Southeastern Association of Game and Fish Commissioners, 1968, 1970. 4 p, 1 tab, 12 ref.

Descriptors: Catfishes, Channel catfish, Acclimatization, *Heat resistance, Heated water, Thermal pollution, *Thermal stress, Resistance, Pigments, Fishkill, Mortality, Water pollution effects, Fish physiology.

Identifiers: *Ictalurus punctatus, *Thermal tolerance survival, *Lethal effects, Albino catfish, *Pigmentation.

Two lots of the Arkansas strain of channel catfish, Ictalurus punctatus, containing both albino and normal fish, were acclimated in the laboratory at a constant temperature of 30.0 deg C. Samples of albino and normal fish were exposed to a lethal temperature of 39.0 deg C. The albinos from both lots had the highest mean survival time, but the differences were not statistically significant. (Sjolseth-Washington)
W70-08651

METABOLISM OF LINDANE BY UNICELLULAR ALGAE,
State University Coll., Buffalo, N.Y. Great Lakes Lab.
Robert A. Sweeney.
Proceedings of the 12th Conference on Great Lakes Research, p 98-102, 1969. 3 fig, 18 ref. USPHS Grant IT-WP-3901-A.

Descriptors: Pesticide residues, Algae, Great Lakes, Metabolism, *Chlorella, *Chlamydomonas Laboratory tests, Gas chromatography, Degradation, Water pollution effects, Aquatic environment, Chlorinated hydrocarbon pesticides, Plant physiology.
Identifiers: *Lindane, *Algae metabolism, Detoxification, Lindane metabolism.

Lindane is an insecticide that has been detected in the Great Lakes Basin. The metabolism of this pesticide by Chlorella vulgaris and Chlamydomonas reinhardtii in axenic culture was ascertained. Each species was cultured in a solution initially containing 4.5, 2.3, or 0.0 ppm lindane. Using chromatographic techniques, a marked decrease in the lindane concentration with time was noted. A substance was observed in extractions of the solutions containing algae and lindane which was not present in extracts from either algae-free cultures containing lindane or from algae in a lindane-free medium. This substance was identified as 1, 3, 4, 5, 6 --pentachloro-cyclohex-l-ene, a non-toxic lindane metabolite. This indicated that Chlorella and Chlamydomonas can metabolize lindane. It also may explain in part the relatively low concentration of this pesticide in the Great Lakes. (Sjolseth-Washington)
W70-08652

PHOSPHATES IN PEORIA LAKE: A QUANTITATIVE AND QUALITATIVE EVALUATION OF A NUTRIENT IN NATURAL WATERS,
Illinois State Water Survey, Peoria. Water Quality Section.
For primary bibliographic entry see Field 02H.
W70-08653

RELATIONSHIPS BETWEEN BACTERIA AND PHYTOPLANKTON,
Byelorussian State Univ., Minsk (USSR). Dept. of Invertebrate Zoology.
For primary bibliographic entry see Field 02H.
W70-08654

SUCCESSION IN ALGAL MAT COMMUNITIES AT THREE NUTRIENT LEVELS,
Oklahoma State Univ., Stillwater. Dept. of Zoology.
Jerry L. Wilhm, and Joseph Long.
Ecology, Vol 50, No 4, p 645-652, 1969. 9 fig, 5 tab, 15 ref.

Descriptors: *Biological communities, *Succession, *Nutrients, Phosphates, Nitrates, Biomass, Pigments, Productivity, Respiration, Ecosystems, Chlorophyll, Chemical properties, Hydrogen ion concentration, Carbon dioxide, Scenedesmus, Bacteria, Protozoa, Rotifers.
Identifiers: *Algal mats, Mougeotia, Anabaena, Oscillatoria, Phormidium, Production-respiration ratio, Production-biomass ratio, Production-chlorophyll ratio.

Ecosystems tend to evolve to a steady state in which net primary production and respiration are balanced and the quantity of biomass constant. It is thought that during succession net primary production decreases at a greater rate than biomass increases and that the ratio between these two variables may be used as indicator of the succession state. Effect of three different levels of phosphates and nitrates on temporal variation of structural and functional parameters was studied in algal mat communities in microcosms, using 1 liter of farm pond water. Most common producers were Mougeotia, Phormidium, and Anabaena. Microcosms receiving the largest input of nutrients were highest in biomass and pigments, but no greater in net production and respiration than microecosystems receiving an intermediate level of nutrients. These four variables remained low in systems receiving the lowest nutrient levels. The ratio of production to respiration approached unity at all nutrient levels. Production/biomass and production/chlorophyll, that is, assimilation number ratios, generally decreased with time and leveled off at all nutrient levels. No effects on the pigment diversity ratio, D-430/D-665 attributable to nutrients were observed. (Jones-Wisconsin)
W70-08657

EFFECTS OF ORGANIC WASTES ON RIVERS,
Water Pollution Research Lab., Stevenage (England).
E. J. C. Curtis, and D. W. Harrington.
Process Biochemistry, Vol 5, No 4, p 44-46, 62, 1970. 3 fig, 3 tab, 14 ref.

Descriptors: *Water pollution effects, *Rivers, *Organic wastes, Effluents, Biological treatment, Biochemical oxygen demand, Bioindicators, Sewage bacteria, Biodegradation, Microorganisms, Water pollution sources, Benthic fauna, Water pollution control, Sewage effluents, Industrial wastes, Slime, Dissolved oxygen.
Identifiers: Filamentous microorganisms, Sewage fungus, Soluble organics, Biotic index, Saprobien system, Portable channels, England.

Effluents containing excessive amounts of organic material produce unfavorable conditions for organisms by direct toxicity or excessive growth of heterotrophic organisms depleting oxygen supplies. Diversity from normal water communities indicates severity of pollution. Organic pollution produces definable zones of pollution severity below effluent discharge. Inorganic nutrients support growth just before recovery zone. Normal sanitary analysis should be performed in addition to biological indicator systems since biological community structure depends on several factors. Filamentous or colonial microorganisms form attached slimes called 'sewage fungus', stimulated by a variety of organic effluents. They are major causes of oxygen depletion and are aesthetically objectionable. Slime production potential of organic effluent is most easily determined by measuring soluble organic content if effluent contains all readily biodegradeable organic compounds. Inorganic nutrients are unlikely to limit slime growth. Removal of organic biodegradable matter from effluents is best done by conventional biological treatment processes. Partial removal has no effect on slime growth. Intermittent discharge of organic effluent controls slime growth by preventing slime build-up. (Bannerman-Wisconsin)
W70-08665

WATER POLLUTION IN REMOTE RECREATIONAL AREAS,
Forest Service (USDA), Duluth, Minn. Superior National Forest.
Michael A. Barton.
Journal of Soil and Water Conservation, Vol 24, No 4, p 132-134, July-August 1969. 4 photo, 1 tab, 7 ref.

Descriptors: *Water pollution, *Recreation, Recreation facilities, Population, Water quality, Monitoring, Nutrients.
Identifiers: Visitor inputs, Natural inputs.

Pollution and/or enrichment of waters in remote recreational areas has generally not proceeded to the same extent that it has in more heavily populated areas. The lack of concentrated population and industries space these areas from the severity of the problem as it exists in urban areas. The small amounts of pollutants and/or nutrients are much more noticeable in this high quality water than in waters already receiving such inputs. Continued population expansion, increased leisure time and affluence will require that wilderness areas absorb greater use. These areas must be protected if they are to survive as an ecological entity. Using standards of clean water normally considered appropriate in water quality control programs, wilderness waters could be degraded significantly before uses other than recreation would be damaged. Little consideration is given to nutrient enrichment in formulating standards. Greater emphasis must be accorded to nutrients, and the aquatic growth they produce and the impact of nutrients on aesthetic qualities. (Loeb-Rutgers)
W70-08694

THERMAL POLLUTION: THE EFFECT OF THE PROBLEM,
La Salle Coll., Philadelphia, Pa.
Charles B. Wurtz.
In: Environmental Problems, edited by Billy Ray Wilson, Philadelphia, L. B. Lippincott Co. 1968, p 131-145.

Descriptors: *Thermal pollution, *Pollution control, Costs, Temperature changes, Trout, Fishing, Cooling, Hydroelectric power, Rivers, Water quality, Dissolved oxygen, Metabolism, Correllation analysis, Productivity, Economic justification, Benefits, Water law, Investment, Fisheries.
Identifiers: *Delaware River, *Metabolic rates.

This paper discusses the effects of artificially increased water temperatures. One of the greatest impediments to controlling thermal pollution is the cost involved. The author discusses the direct relation between cost and water quality and gives some examples of the difficulty of deciding which investment to make. The paper also discusses the biological effects of increased water temperature. The author disputes some of the current thinking and analyzes the effect of thermal pollution on dissolved oxygen, and the metabolic rates of living organisms. Heat added to the water will increase the productivity of that water, and, in the long run, bring higher fish yields. The author concludes with an analysis of the costs of controlling water pollution and argues for realistic goals in control regulations. (Murphy-Rutgers)
W70-08719

POLLUTION CONTROL: WHY HAS IT FAILED,
Arnold W. Reitze.
American Bar Association Journal, Vol 55, Oct. 1969, p 923-927.

Descriptors: *Water pollution effects, *Pollution abatement, *Air pollution, *Water pollution control, Pollutants, Water pollution, Water pollution sources, Wastes, Soil condemnation, Thermal pollution, Air pollution effects, Effects, Public health, Agricultural chemicals, Fertilizers, Detergents, Domestic wastes, Mine wastes, Coordination, Federal government, State governments, Administrative agencies, Environment, Legislation, Industries.

Examining problems that arise with increasing environmental pollution, this article contends that to curtail an impending environmental crisis there must be an increasing concern at all levels of society. Various causes, sources, and effects of pollution are noted. The author calls for three types of

control methods to check pollution. First, there must be a development of public hostility towards pollution. Second, there must be established legal controls and sanctions and a concentrated and centralized effort by federal and state governments to approach the pollution problem. The effectiveness of various agencies are noted, especially the Federal Water Pollution Control Administration; nevertheless, a more centralized effort in the overall area of pollution is called for. Third, the article suggests that economic sacrifice is essential to the fight against pollution. The author notes that any answer to the pollution problem will be costly to government, industry, business, and individuals, but the burden must be accepted. (Snow-Florida)
W70-08812

TOLERANCE OF MYSIS RELICTA TO THERMAL SHOCK AND LIGHT,
Federal Water Pollution Control Administration, Duluth, Minn.
Wesley E. Smith.
Transactions of the American Fisheries Society, Vol 99, No 2, p 418-422, April 1970. 7 fig, 9 ref.

Descriptors: *Water temperature, *Heat resistance, *Ambient light, Resistance, Aquatic animals, Bioassay, Lethal limit, Mortality, Acclimatization, Light, Temperature, Thermal stress.
Identifiers: *Mysis relicta, Thermal shock.

Tests were conducted to determine the thermal tolerance and effects of laboratory illumination on survival of Mysis relicta. Mysids were affected adversely by heat stress when temperatures rose about 10C. When acclimated to a temperature of 7.5C, this species has 96-hour median tolerance limits of 16 to 16.5C. Percent mortality was essentially the same when the animals were subjected immediately to test temperatures, as when temperatures were raised gradually from acclimation temperature over a period of 5 hours. When acclimated to a temperature of 4.5C and then subjected to temperature elevations of 1, 2.5, and 5C per day, 50% of the animals died at 16C in 16 days, 18C in 6 days, and 16C in 4 days, respectively. Mysis relicta is an organism requiring considerable time for effective acclimation. Mysids were intolerant of exposure to normal laboratory illumination. The species lived satisfactorily in light of 10 hours a day for 2 weeks, but this period was followed by a steady mortality of about 8% of the original population per week. (Hsieh-Vanderbilt)
W70-08824

THE CALEFACTION OF A RIVER,
Connecticut Water Resources Commission.
Daniel Merriman.
Scientific American, Vol. 222, No. 5, p 42-52, 10, 148, May 1970. 7 fig, 32 ref.

Descriptors: *Thermal pollution, *Nuclear powerplants, Cooling water, Thermal stratification, Benthic fauna, Fish population, Fish reproduction.
Identifiers: *Calefaction, Thermal block.

An interim report is presented on a survey (1965-1972) on the thermal disturbances of the Connecticut River by heated water from the Connecticut Yankee Haddam Neck's Nuclear powerplant and its biological effects. The location of the water with a higher temperature than normal due to the heated water discharge was given for the seasonal low flow of the river when the river water temperature was at its seasonal high. No thermal block was found. The survey data on the river biology indicate that there has been no significant deleterious effect on the biology of the river though there have been changes in the flora near the plant, in the bottom fauna at the point of effluent discharge and in the condition of the bottom habitat near the plant intake. No significant influence on the river's fish population was found. The catfish entering the cooling water discharge-canal do not fare as well as in the river. (Rietveld-Vanderbilt)
W70-08825

THE ECOLOGY OF FLOWING WATERS IN RELATION TO MANAGEMENT,
Waterloo Univ. (Ontario).
H. B. N. Hynes.
Journal of Water Pollution Control Federation, Vol. 42, No. 3, p 418-424, March 1970. 10 ref.

Descriptors: *Ecology, *Temperature, *Biology, *Fish, *Water quality control, Fungi, Watershed management, Ecosystems, Streams.

Four aspects of the ecology of running water are discussed in relation to the management of watersheds. They are temperature, substratum, the sources of food for invertebrates, and the breeding requirements of fish. It is shown how each may be altered almost inadvertently by man with far-reaching biological effects. These may be deleterious or desirable, but often they are unanticipated by nonbiologists, and even the ecologist cannot claim that he will not meet surprises. A plea is made, therefore, for greater ecological education of watershed managers and much more interdisciplinary consultation in the planning of management programs. We should develop an appreciation of the likely biological consequences of our action and included in our value judgments. (Rietveld-Vanderbilt)
W70-08826

TIME AND EXTENT OF A FLOW REVERSAL IN THE LOWER COLUMBIA RIVER,
Bureau of Commercial Fisheries, Seattle, Wash.
For primary bibliographic entry see Field 02L.
W70-08831

THE RESPONSES OF YOUNG AMERICAN SHAD TO RAPID TEMPERATURE CHANGES,
Essex Marine Lab., Conn.
Sanford A. Moss.
Transaction of the American Fisheries Society, Vol 99, No 2, p 381-384, April 1970. 1 fig, 1 tab, 6 ref.

Descriptors: *Temperature, *Fish behavior, *Migration pattern, *Heated water, Lethal limit, Nuclear powerplants, Cooling water, Fish kill, Thermal pollution, Thermal powerplants.
Identifiers: Shad.

Preliminary experiments indicated that young American shad (Alosa sapidissima) experience rapid mortality when temperatures are quickly raised from an ambient temperature of 24 to 28C up to 32.5C. Temperature increases of this magnitude (Delta T = 5 to 9C) are within the range predicted for portions of the Connecticut River that are affected by the Connecticut Yankee Atomic Power Company cooling water discharge. This study is to learn how young shad behave upon encountering rapidly changing temperatures. Captive juvenile American shad avoided rapid temperature increases of about 4C above acclimatization temperatures in an experimental tank. Responses to rapid temperature changes of about 1.0C were not consistent and did not result in demonstrable avoidances. Young shad are capable of avoiding potentially lethal temperature changes. (Osborne-Vanderbilt)
W70-08833

HEAT AS A POLLUTANT,
General Electric Co., Richland, Wash.
Robert T. Jaske.
Oregon State Univ. Water Resources. Research Institute Water Quality Control Seminar Proceedings, Session 7, p 61-82, November 1964. 10 fig.

Descriptors: *Thermal pollution, *Temperature, Hydrogen ion concentration, Nutrients, Algae, Fish, Stratification, Flocculation, Turbines, Economic efficiency, Heat budget, Social aspects.

The effects of increased temperature on pH, nutrients, algae, taste, and fish are discussed. The advantages and disadvantages of stratification, flocculation, and other variations in the fluid mechanics of streams are considered. A specific example of a typical heat-producing industrial process of a turbine generator plant is examined. The efficiency and the overall plant economy is determined for varying temperatures of the effluent. Problems arising from stream size and the erection of dams and reservoirs are mentioned. Three primary concerns of further research include: (1) improved attention to heat budgets and mathematical treatment of air-water transport phenomena; (2) closer identification of the specific changes associated with the temperature parameter; and (3) improved standardization and methods of economic analysis for identification of the significant economic factors involved. (Osborne-Vanderbilt)
W70-08834

THE EFFECTS OF ELEVATED TEMPERATURE UPON AQUATIC INVERTEBRATES-A REVIEW OF LITERATURE RELATING TO FRESH WATER AND MARINE INVERTEBRATES,
Johns Hopkins Univ., Baltimore, Md. Dept. of Geography; and John Hopkins Univ., Baltimore, Md. Dept. of Environmental Engineering Science.
Loren D. Jensen, Robert M. Davies, Arthur S. Brooks, and Caldwell D. Meyers.
Johns Hopkins Univ., Cooling Water Studies, Report No 4, 1969. 232 p, 384 ref, 14 fig, 6 tab.

Descriptors: *Aquatic environment, *Invertebrates, *Temperature, *Thermal stress, *Thermal pollution, Amphipoda, Aquatic insects, Commercial shellfish, Copepods, Crayfish, Crabs, Crustaceans, Insects, Isopods, Lobsters, Mollusks, Mussels, Oysters, Shrimp, Snails, Worms, Aquatic animals, Heated water, Estuaries, Marine animals, Brackish water, Heat resistance, Cold resistance, Fresh water.
Identifiers: Poikilotherms.

Literature directly concerning the effect of elevated temperatures upon both freshwater and marine invertebrates has been reviewed. The review has been limited to major invertebrate groups and does not, because of the lack of published data in some areas, include a uniform treatment of all the groups. The review was written as a source of information for the non-professional biologist. There are three sections. The first introduces the role of temperature in the biology-ecology of the aquatic ecosystem and the effect of temperature on the environment. Section two is an introduction to major invertebrate groups, their morphology and life history, and a review of the published information on the effect of elevated temperatures on the whole animal and the effect on reporduction and development. The third section presents conclusions and interpretations drawn from the published data discussed in sections one and two. (Speakman-Vanderbilt)
W70-08835

RESEARCH IN THERMAL POLLUTION CONTROL,
American Water Resources Association, Urbana, Ill.
Frank H. Rainwater.
Proceedings 4th American Water Resources Conference, Nov. 18-22, 1968. American Water Resources Assn. Urbana, Ill., Ill., 1969. p 140-145.

Descriptors: *Thermal pollution, *Water temperature, Evaporation, Cities, Heat transfer, Mathematical models, Meteorological data, Aquatic life, Cooling, Balance of nature, Economic efficiency.
Identifiers: *Water heat, AEC.

Until recently, Americans have not been aware of thermal pollution and its consequences. Since decisions made today will determine what powerplants go on line six or seven years from now, research is of prime importance. Short-term goals for this research should include: (1) a better understanding of the physics of heat input, transport and dissipation in water resources along with non-empirical,

stochastic, thermal mathematical modeling; (2) a better knowledge of the effects of aquatic biota and identification of species having special ecological and economic importance; and (3) increased thermal efficiency and water consumption of cooling devices. Long-term goals should include research results leading to practical power generation by advanced techniques, energy cycles that reject substantially less heat to the environment, and a management approach involving the whole concept of energy utilization. However, the ultimate success in thermal pollution control depends on the regulatory agency, the polluter, and the user of water doing his part, research being done on priority items, and emphasis focused on how to prevent and abate thermal pollution - not on how to justify it. (Osborne-Vanderbilt)
W70-08840

WATER QUALITY AND THE MIGRATION OF FALL SALMON IN THE LOWER WILLAMETTE RIVER,
Oregon Fish Commission, Astoria.
Roy E. Sams, and Kelly R. Conover.
Final Report, May, 1969. 58 p, 23 fig, 22 tab.

Descriptors: Water pollution effects, Chinook salmon, *Water quality, *Water temperature, *Fish migration, *Dissolved oxygen, Water levels, Oregon, Columbia River, Time of Concentration, Streamflow, Impaired water quality, Fish management, Fish barriers, Anadromous fish.
Identifiers: Coho salmon, *Willamette River.

Water quality and salmon migration data for the lower Willamette River were collected and analyzed to determine if water quality affected the migration of salmon. Some of the more important conclusions are: (1) Columbia River Coho salmon occur over a wide period of time, usually peaking in late October; (2) Chinook begin in early September; (3) Initial passage of chinook and coho over Willamette Falls was not preceded by a significant increase or decrease in streamflow; (4) At times low tides may have restricted passage over the falls; (5) 73 deg F water in the Willamette has not blocked fish from entering the river and (6) no salmon were observed passing over Willamette Falls until the D.O. level rose to 5 ppm or above. (Sjolseth-Washington)
W70-08920

SEAFOODS PROCESSING: POLLUTION PROBLEMS AND GUIDELINES FOR IMPROVEMENT,
Oregon State Univ., Corvallis. Dept. of Food Science and Technology.
M. R. Soderquist, K. J. Williamson, and G. I. Blanton.
Proceedings of the National Symposium on Food Processing Wastes, Apr 6 - 8, 1970, Portland, Oregon. p 189-225, 65 ref, 8 tab, 7 fig. FWQA Grant 12060 ECF.

Descriptors: *Water pollution sources, Water pollution effects, *Water pollution control, Pollution abatement, Marine fisheries, Herrings, *Waste disposal, Research and development, Bottom fish, Crabs, Salmon, Canneries, Commercial fishing, Shrimp, Byproducts, On-site investigations, *Waste water treatment, Industrial wastes.
Identifiers: Menhaden, *Seafood processing, Tuna processing, Waste characteristics, Canning, Byproduct recovery.

The processing is discussed of the major United States seafoods species, the resultant waste water strengths and flows, solid wastes magnitudes, current treatment and by-product recovery methods, and current and recommended research in water pollution abatement. The paper was based on a comprehensive literature review and extensive on-site investigations of current research, processing, and treatment activities in the major seafoods centers of the U.S. (Sjolseth-Washington)
W70-08921

THE EFFECT OF TEMPERATURE ON THE RATE OF DEVELOPMENT AND SURVIVAL OF ALEWIFE EGGS AND LARVAE,
Bureau of Commercial Fisheries, Ann Arbor, Mich. Great Lakes Fishery Lab.
Thomas A. Edsall.
Trans Amer Fish Soc, Vol 99, No 2, p 376-380, 1970. 12 ref, 4 fig.

Descriptors: Lake Michigan, *Water temperature, Water pollution effects, Mortality, Fishkill, Fish eggs, *Hatching, *Viability, Incubation, Larval growth stage.
Identifiers: *Alewives, Water temperature effects, Development rate, Survival, *Egg mortality, *Hatching success, *Incubation time.

Eggs from Lake Michigan alewives (Alosa pseudoharengus) were incubated at 79 different temperatures from 42.1 to 87.0 F. Hatching occurred at 44.4--84.9 F and was optimum (38% hatched) at about 64 F. Incubation time varied from 15 days at 45 F to 3.7 days at 70 F and 2.1 days at 84 F. Time from start to finish of hatching ranged from 13 days at about 46 F to 2-3 days at 68-70 F and 1-2 days at 80-84 F. Survival of unfed larvae held at incubation temperatures increased from 3.8 days at 51 F to 7.6 days at 58-59 F and then decreased to 2.4 days at 80-82 F. (Sjolseth-Washington)
W70-08922

PESTICIDE MONITORING OF THE AQUATIC BIOTA AT THE TULE LAKE NATIONAL WILDLIFE REFUGE,
Federal Water Quality Administration, Klamath Falls, Oreg.
Patrick J. Godsil, and William C. Johnson.
Pesticides Monitoring Journal, Vol 1, No 4, p 21-26, 1968. 8 ref, 5 tab, 4 fig.

Descriptors: *Chlorinated hydrocarbon pesticides, DDT, Endrin, *Pesticide residues, Pesticide toxicity, Water pollution effects, *Monitoring, *Water quality, Aquatic environment, On-site data collections, On-site investigations, Clams, Water birds, Bass, Mortality, Bottom sediments, Aquatic plants, Oregon, California.
Identifiers: DDD, DDE, Chlordane, *Water quality monitoring, *Pesticide monitoring, Tule Lake (Calif), Lower Klamath Lake (Calif), Lost River (Oregon).

Over a 2-year period, samples of water, suspended material, submerged aquatic plants, clams, and fish were collected from the Tule Lake area and analyzed for chlorinated hydrocarbon pesticides. Compounds DDE, DDD, DDT, chlordane, and endrin were found regularly in samples of both water and biota. Water contained a maximum of 0.100 ppb of endrin in 1965, while tui chubs accumulated a maximum of 198 ppb during the same year. Concentrations of endrin in the other strata of the biota were distributed between these extremes of the food chain. The occurrence of endrin was directly associated with contaminated irrigation return water supplying the Refuge lakes. As the concentrations of studied pesticides increased in the drainage water, the biota also became contaminated. However, at the end of the season, as the concentrations decreased in the water, the biota was cleaned. Concentrations in both water and biota returned to or near analytical sensitivity (water--0.007 ppb; biota--4 ppb) between growing seasons. (Sjolseth-Washington)
W70-08923

OCCURRENCE OF PESTICIDES IN WHALES,
Bureau of Commercial Fisheries, Seattle, Wash.
Allen A. Wolman, and Alfred J. Wilson, Jr.
Pesticides Monitoring Journal, Vol 4, No 1, p 8-10, 1970. 2 tab, 16 ref.

Descriptors: *Chlorinated hydrocarbon pesticides, *DDT, *Dieldrin, Pesticide residues, Analytical techniques, Endrin, Aldrin, Gas chromatography.
Identifiers: *Gray whales, *Sperm whales, *Tissue samples, Brain tissues, Liver tissues, Blubber tissues, Tissue analysis, DDE, DDD, Toxaphene, Heptachlor epoxide, Polychlorinated Biphenyls, Methoxychlor.

Organochlorine pesticides were found in tissue samples of brain, blubber, and liver from 6 of 23 gray whales, Eschrichtius robustus, and in each of 5 sperm whales, Physeter catodon, collected near San Francisco, Calif., in 1968 and 1969. Concentrations of DDT or its metabolities ranged up to 0.36 ppm in blubber tissue of gray whales, and 6.0 ppm in blubber tissue of sperm whales. The highest dieldrin concentrations were 0.075 ppm in gray and 0.019 ppm in sperm whales. (Sjolseth-Washington)
W70-08924

TEMPERATURE, REPRODUCTION AND BEHAVIOR,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
Charles C. Coutant.
Chesapeake Science Vol 10, No 3 and 4, p 261-274, 1969. 15 fig, 2 tab. AEC Contract AT (45-1)-1830.

Descriptors: Water pollution effects, Thermal powerplants, *Thermal stress, Thermal water, Water temperature, *Fish reproduction, *Fish behavior, *Fish populations, Fish physiology, Predation, Hatching, *Spawning, Fish management, Salmonids, Columbia River, Fish eggs, Viability, *Nuclear powerplants, Chinook salmon, On-site investigations, Mortality, Equilibrium, Washington.
Identifiers: Hanford (Washington), *Thermal effects.

Research being conducted on salmonid fishes at the Hanford nuclear complex on the Columbia River is discussed. Studies of thermal effects on reproduction and behavior include a 20-year, annual census of spawning chinook salmon near reactor discharges, laboratory experiments on incubation and rearing success at elevated temperatures, studies of equilibrium loss prior to thermal death at lethal temperatures, tests of relative predation rates upon thermally shocked and normal young salmonids, and tracking sonic tagged adults to determine migration behavior near thermal outfalls. (Sjolseth-Washington)
W70-08925

HISTOLOGICAL AND ELECTRON MICROSCOPICAL OBSERVATIONS ON COPPER POISONING IN THE WINTER FLOUNDER (Pseudopleuronectes americanus).
McGill Univ., Montreal (Quebec). Marine Sciences Centre.
Jeremy T. P. Baker.
J. Fish. Res. Board Canada 26: 2785-2793, 1969. 25 ref, 19 fig.

Descriptors: *Copper, Copper sulfate, Heavy metals, Water pollution effects, *Fish physiology, Fishkill, Mortality, *Toxicity, Electron microscopy, *Microscopy.
Identifiers: Winter flounder, *Pseudopleuronectes americanus, *Histology, Gill Lamellae.

Effects of high (3200 microgram/liter Cu (++)) medium, (560-1000) and low levels (180 microgram/liter Cu (++)) of copper on the morphology of winter flounder were investigated. High and medium levels resulted in fatty metamorphosis in the liver, necrosis in the kidney, destruction of the hemopoetic tissue, and gross changes in gill architecture. Light microscope studies showed that low levels of copper caused an extracted appearance in gill lamellae; the epithelial layer appeared vacuolated; the basi-lamellar region was reduced in thickness. Lamellar mucus cells were few compared with control specimens and chloride cells appeared in their stead. Electron microscope study of gill lamella from fish exposed to low levels of copper confirmed vacuolation in the epithelial layer. Also found were myelinlike figures, various membrane-bound vesicles, and apical homogene-

ous layers of reduced thickness. Increased amounts of particulate matter adhering to the external surface of the epithelial cells were apparent. Chloride cells were found instead of mucus cells. (Sjolseth-Washington)
W70-08926

SURVIVAL AND GROWTH OF LARVAE OF THE EUROPEAN OYSTER (OSTREA EDULIA L.) AT DIFFERENT TEMPERATURES,
Bureau of Commercial fisheries, Milford, Conn.
Harry c. Davis, and Anthony Calabrese.
The Biological Bulletin, Vol 136, No 2, p 193-199, April 1969. 2 tab, 1 fig, 9 ref.

Descriptors: Water temperature, Oysters, Growth rates, Larval growth stage, Mortality, Bioassay, Shellfish.
Identifiers: Ostrea edulis, Optimum growth temperature, Survival, Spat.

The temperature range for satisfactory growth of O. edulis larvae (70% or more of optimum) was from 17.5 deg. to 30C. The temperature range for satisfactory survival (70% or more of optimum) was from 12.5 deg. to 27.5C. Even at 10C survival was poor, perhaps, because the unfavorable temperatures weakened the larvae, making them more susceptible to bacterial toxins and diseases. In these experiments approximate setting times were as follows: 17.5C-26 days, 20C-14 days, and at 25 deg. 27.5 deg, and 30C beginning of setting varied from the 8th to the 12th days. More spat were obtained at 20 deg to 22.5C than at higher temperatures. It is suggested that larvae be reared to setting size at temperatures from 25 deg to 27.5C, then kept at 20 deg to 22.5C during setting to obtain fastest growth of larvae and highest percentage setting. Spat kept at 10C showed virtually no growth; at temperatures from 12.5C growth of spat increased with each increase in temperature. (Sjolseth-Washington)
W70-08927

THE pH TOLERANCE OF EMBRYOS AND LARVAE OF MERCENARIA MERCENARIA AND CRASSOSTREA VIRGINICA,
Bureau of Commercial Fisheries, Milford, Conn.
Anthony Calabrese, and Harry C. Davis.
Biological Bulletin, 1966. Vol 131, No 3, p 427-436. 6 tab, 10 ref.

Descriptors: *Hydrogen ion concentration, Clams, Oysters, *Larvae, Larval growth stage, *Embryonic growth stage, Resistance, Mortality, Bioassay, Growth rates.
Identifiers: *pH tolerance, Mercenaria mercenaria, Crassostrea virginica.

The pH range for normal embryonic development of oysters (Crassostrea virginica) was 6.75 to 8.75, and for clams, (Mercenaria mercenaria), 7.00 to 8.75. More than 68% of the larvae of both clams and oysters survived at pH 6.25 to 8.75. The lower pH limit for survival of oyster larvae was 6.00 and for clam larvae, 6.25. The pH range for normal growth was 6.75 to 8.50 for clam larvae and 6.75 to 8.75 for oyster larvae. The rate of growth of both species dropped rapidly at pH levels below 6.75. The optimum pH for growth was 7.50 to 8.00 for clam larvae and 8.25 to 8.50 for oyster larvae. At pH 9.00 to 9.50 the percentage of eggs that developed normally, the percentage of larvae that survived, and the percentage increase in mean length of both species decreased rapidly. (Sjolseth-Washington)
W70-08928

THE CHRONIC TOXICITY OF LINEAR ALKYLATE SULFONATE TO THE FATHEAD MINNOW (PIMEPHALES PROMELAS, RAF.),
Federal Water Pollution Control Administration, Cincinnati, Ohio. Newtown Fish Toxicology Lab.
Quentin H. Pickering, and Thomas O. Thatcher.
Journal of Water Pollution Control Federation, Vol 42, No 2, Part 1, Feb 1970, p 243-254. 8 tab, 28 ref.

Descriptors: Toxicity, Water quality, Detergents, Linear alkylate sulfonates, Effects.
Identifiers: Fish, Chronic toxicity.

A continuous flow bioassay was made for the appraisal of the chronic toxicity of linear alkylate sulfonate (LAS) to the fathead minnow (Pimephales promelas, Rafinesque). The toxicological effect investigated was fish production based on survival, growth, and reproduction. Statistical analysis of the data from newly hatched fry survival indicated a significantly greater mortality at the two high test concentrations. At a concentration of 0.63 mg LAS/l fish production was similar to the control fish. An application factor obtained by dividing the maximum acceptable toxicant concentration by the 96-hour TLm value was found to be between .14 and .28.
W70-08930

BIOLOGICAL EFFECTS ON SEDIMENT-WATER NUTRIENT INTERCHANGE,
California Univ., Berkeley. Sanitary Engineering Research Lab; and Sunn, Low, Tom, and Hara, Inc., Honolulu, Hawaii.
Donald B. Porcella, James S. Kumagai, and E. Joe Middlebrooks.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 96, No SA4, Paper 7460, p 911-926, August 1970. 5 fig, 8 tab, 10 ref. Contract AT (11-1)-34 - Project 100, AEC.

Descriptors: *Nutrients, *Bottom sediments, *Limnology, *Algae, *Eutrophication, Lakes, Water quality, Phosphorus, Phosphates, Productivity, Leaching.
Identifiers: Sediment-water nutrient-exchange.

Different types of sediments vary in their ability to support algal growth. This is related to the amount of available phosphorus measured in the sediments. Although the amount of phosphorus released from the sediments varied with the type of sediment, all of the available phosphorus eventually should be extracted in the 15-cm layer of sediment studied. The development of a thick mat of Oscillatoria caused an increase in productivity due to the increased transfer of phosphorus from the sediment; and, in general, the more productive systems had sediments containing greater amounts of phosphorus. Also, the equilibration of P-32 with stable phosphate occurred more rapidly in the more productive systems, and this rate of equilibration appeared to be associated with the sediments themselves. Hence P-32 exchange with stable P was related to the concentration of available phosphorus in the system. (Knapp-USGS)
W70-08944

5D. Waste Treatment Processes

ADVANCES IN WATER POLLUTION RESEARCH.
For primary bibliographic entry see Field 05G.
W70-08627

MODIFIED FILTER MEDIA FOR REMOVAL OF WATER POLLUTANTS,
Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
G. D. Agrawal, and A. V. S. Prabhakara Rao.
In: Advances in Water Pollution Research, Proceedings 4th International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, p 299-307, 1969. 9 p, 5 fig, 10 ref.

Descriptors: *Water pollution control, *Filtration, *Particle size, *Clays, *Silts, Sands, Algae, Plankton, Microorganisms, Turbidity, Analytical techniques, Laboratory tests, Foreign research.
Identifiers: *Filter media, Alumina-coated sand, Ferric oxide-coated sand, Crushed bauxite, Acid-washed bauxite, Kanpur (India).

Experiments were made to develop a simple filter, with modified media, for efficient removals of micro sized particles, whether used for disposal to exclude particulate pollutants from effluents or for water supply to remove particulate contaminants. Two pyrex glass tubes were used to contain the filter columns. The filter bed for all the runs was a 7.6 cm layer of shingle and coarse sand supporting an 18 cm layer of the media under study. Filter media consisted of untreated sand, sand coated with alumina, sand coated with ferric oxide, crushed low-grade bauxite and bauxite washed with acid. Water with less than 10 mg/l. turbidity could be produced by filtration of raw stream water (influent turbidity 46 mg/l.) or raw pond water (influent turbidity 32 mg/l.) and reduced the total bacterial numbers by about 50%. (Woodward-USGS)
W70-08628

STREAM REAERATION USING MOLECULAR OXYGEN,
Crown Zellerbach Corp., Camas, Wash. Dept. of Manufacturing Services.
For primary bibliographic entry see Field 05G.
W70-08644

VISCOSE RAYON FACTORY WASTES AND THEIR TREATMENT,
C. P. Sharda, and K. Manivannan.
Technology (Sindri, India) Spec. Issue, Vol 3, No 4, p 58-60, 1966.

Descriptors: *Sulfides, Neutralization, Alkalinity, Acidity, Trickling filters.
Identifiers: *Viscose rayon, Zinc compounds, Tire cord.

The process of viscose rayon manufacturing is briefly described. The effluents from the factory are classified as alkaline viscose residues, acid sulfide, and sanitary. The combined waste treatment may be difficult and sep. treatment is recommended. The process adopted includes neutralization and settlement, incineration, neutralization with lime or limestone and trickling filter. The addnl. problem of removal of zinc compounds from viscose tire cord plant residues is mentioned. (Livengood-North Carolina State)
W70-08655

FLOCCULATION AND DEFLOCCULATION OF AN AQUEOUS SUSPENSION OF CHLORELLA,
Tokyo Univ. (Japan). Inst. of Applied Microbiology.
Shuichi Aiba, Takeshi Watanabe, and Makoto Hirata.
Journal of Fermentation Technology, Vol 48, No 3, p 125-136, 1970. 10 fig, 1 tab, 16 ref.

Descriptors: *Flocculation, *Chlorella, Suspension, Turbidity, Size, Surface tension, Shear stress, Viscosity, Sewage, Industrial wastes, Activated sludge, Cultures, Mathematical studies, Light intensity, Temperature, Sludge.
Identifiers: *Deflocculation, *Aqueous suspensions, Sensor, Cadmium sulfide, Chlorella vulgaris.

Many questions on flocculation and deflocculation of sludge remain to be resolved. The primary purpose of this study was the establishment of a method for assessing the process of microbial flocculation and deflocculation in a generalized fashion, Chlorella being a favorable test organism. A specific sensor of cadmium sulfide was constructed for a continuous assessment of flocculation and/or deflocculation of a dilute and well-dispersed aqueous suspension of Chlorella cells in an agitated vessel. Reading of a millivolt recorder in a circuit of the sensor could readily be converted to the turbidity value; this was correlated fairly well with the mean surface diameter of the floc. The decrease/increase of turbidity of the cell suspension reflected progress of flocculation or deflocculation. Good reversibility, depending on agitation intensity, was confirmed between flocculation and

deflocculation of the cell suspension. Water content of floc in the vessel was also correlated favorably with the ratio of the mean floc size to the cell diameter. The deflocculation was analyzed from a force balance between the pseudosurface tension of the floc and the shear stress due to the liquid viscosity. (Jones-Wisconsin)
W70-08656

MINE WATER TREATMENT--FRICK DISTRICT,
United States Steel Corp., Pittsburgh, Pa.
R. R. Godard.
Mining Congress Journal, Vol 56, No 3, p 36-40, 1970. 4 fig, 6 photos.

Descriptors: *Mine wastes, *Acid mine water, *Coal mine wastes, *Mining, *Mine drainage, Settling basins, Lime, Iron, Alkalinity, Water pollution sources, Water treatment, Waste water treatment, Industrial wastes, Pennsylvania, Sludge disposal, Fertilizers, Productivity.
Identifiers: US Steel Corporation, Frick District (Pa), Mine water treatment.

A short history of US Steel's attempts at pollution abatement since early 1900's is presented. Neutralization of acid mine water with lime was practiced in 1915 and potable water used to quench coke. Treatment problems were similar to those today. Expense of neutralizing treatment was compensated by selling the precipitate as fertilizer and for removing hydrogen sulfide from natural gas. In 1957 settling ponds were built in Frick District to settle ferric iron from alkaline mine water; discharge from the current pond contains less than 7 milligram/liter iron. Maple Creek mine reduced alkalinity of 350-610 milligram/liter to 330-420 milligram/liter by aeration and holding pond system. Treatment of mine waters with pH of 2.9-33, acidity of 500-1600 milligram/liter and iron content of 300-800 milligram/liter from Robena mine resulted in water with pH 7.3-8.5 and total iron content of 2 to 4 milligram/liter, and no acidity. Treatment facility includes 8 million-gallon raw water storage pond, variable speed lime feeder, slurry mixing chambers, aerating basin, and 140 million-gallon settling pond. (Bannerman-Wisconsin)
W70-08668

APPLICATION OF THE DISSOLVED OXYGEN ELECTRODE TO TREATABILITY STUDIES OF INDUSTRIAL WASTES,
Department of Water Resources, Durham, N.C.
Leslie A. Matthews.
Southern Water Resources and Pollution Control Conference, Vol. 13, p 89-96, April 1964. 9 fig, 6 ref.

Descriptors: *Biological treatment, Respiration, Oxygen, Electrodes, Waste waters, North Carolina, Biochemical oxygen demand, Dissolved oxygen.
Identifiers: *Textile mill wastes, *Metal plating wastes, pH.

Industrial wastes can be treated biologically when the wastes are not toxic to the organisms, and proper environmental and nutritional requirements are met. A respiration technique using an oxygen electrode to evaluate the biological treatability of the waste waters does not require pilot plants or extensive time and equipment. This technique is especially useful in determining the effects of unknown wastes on a biological system. Results of studies on metal plating and textile wastes made at Durham, North Carolina, are given. BOD, pH, dissolved oxygen content, and oxygen uptake are emphasized. (Lonon-North Carolina State)
W70-08729

ANAEROBIC DIGESTION OF INDUSTRIAL WASTES,
C. A. Sastry, and G. J. Mohanrao.
Environmental Health (India), No. 5, p 279-288, 1963. 5 tab, 57 ref.

Descriptors: Biochemical oxygen demand, Soaps, Chemical analysis, Anaerobic digestion.
Identifiers: *Wool scouring wastes, Wool grease.

In a section, pages 285-286, the problem of wool scouring wastes is discussed very briefly with a table giving the composition of a typical sample. The entire article covers the anaerobic digestion of industrial wastes with special references to waste waters from slaughterhouses, distilleries, yeast culture, paper mills, dairies, and pea processing. (Livengood-North Carolina State)
W70-08730

FINDING THE BEST WAY TO TREAT WASTES FROM A BLANKET MILL,
Chatham Mfg. Co., Elkin, N.C.
Arthur L. Smith.
Waste Engineering, Vol. 32, No. 5, p 230-233 and 257, 1961. 9 fig, 1 tab.

Descriptors: *Aeration, Wastes water, Copper compounds, Fibers, Screens, Suspended load, Biochemical oxygen demand, Sludge, Cotton, Sludge digestor, Dissolved oxygen, Order.
Identifiers: *Textile mill wastes, Pilot study, Dyehouse wastes, Blanket mill wastes, Wool grease, Mordant dyes, Antibacterial finishes, Wool, Rayon (Regenerated cellulose fibers), Acrylic fibers, Polyamides, Yadkin River, North Carolina Stream Sanitation Committee, pH.

A four-year pilot study was made dealing solely with development and design of modified aeration techniques. The wastes to be treated included dyehouse wastes, wool grease, chrome dyestuffs, copper fixing agents a bacteriostactic agent, and wool, rayon, cotton, acrylic, and polyamide fibers. The Yadkin River into which these wastes were discharged was classified as a Class C stream by the North Carolina Stream Sanitation Committee. A 60-mesh vibrating screen was used to take out large suspended solids. The wastes were aerated most satisfactorily at a pH of 7.0 to obtain a high removal of BOD. Sludge was picked up by air lifts and taken back to the aeration tank or to the sludge diester. A 3:1 air-to-wastes ratio was found to be the minimum at which the dissolved oxygen content could be maintained at required levels. If needed, the sludge was aerated while in the digestor. Nuisance from odors was created in either the wastes or in the sludge using this method. (Lonon-North Carolina State)
W70-08731

WATER CONSERVATION AND POLLUTION ABATEMENT,
R. Hobart Souther.
American Dyestuff Reporter, Vol. 51, No. 9, p 41-44, April 30, 1962. 2 tab.

Descriptors: *Aeration, Water conservation, Water pollution, Waste treatment, Trickling filters, Activated sludge.
Identifiers: *Textile mill wastes, Biosorption.

The great increase in water usage has brought about an urgent need for more research and trained personnel in water conservation. Research funds for water pollution studies need to be spent on applied research rather than basic research. With todays new methods and equipment, proper waste treatment is not as costly as it once was. Particularly successful in textile waste treatment is the aeration lagoon process. Highly alkaline mill waste waters combined with sewage can be treated in trickling filters combined with activated sludge processes without chemical adjustments. The biosorption process can also be used to increase the capacity of conventional sludge plants. Results and costs of aeration techniques are given. (Lonon-North Carolina State)
W70-08733

BIOLOGICAL TREATMENT OF TEXTILE WASTES,
Weston (Roy F.), Inc., Newton Square, Pa.
Vernon T. Stack, Jr., E. L. Jones, T. A. Alspaugh, and H. B. Stokes.
Purdue University Engineering Extension Series Series No. 109, Vol. 46, No. 2, p 387-422, March 1962. 29 fig, 5 tab, 2 ref.

Descriptors: *Biological Treatment, Waste waters, North Carolina, Streams, Biochemical oxygen demand, Color, Activated sludge, Aeration, Cotton.
Identifiers: *Textile mill wastes, pH.

Laboratory and pilot studies were made to design biological treatment facilities for the waste waters from four textile plants in Greensboro, North Carolina. Three million gallons per day of waste from cotton goods processing are discharged into North Buffalo Creek. This stream is classified as a class D stream by the North Carolina Stream Sanitation Committee. The wastes are high in BOD, color content, and pH. Satisfactory treatment is accomplished by activated sludge in a complete-mixed process. A 98 percent removal of BOD is obtained in warm weather. Wastes are aerated at pH 11.5 without neutralization. This aeration gives an effluent pH of 8.5. Color removal is 80 percent. (Lonon-North Carolina State)
W70-08734

CAUSTIC RECOVERY HELD TO PAY HALF ITS COST IN YEARS,
Allied Chemical Corp., Syracuse, N.Y. Solvay Process Div.
W. R. Steele.
Daily News Record, No. 190, No. 21182, p 41, September 29, 1961.

Descriptors: Water pollution, Surveys.
Identifiers: *Textile mill wastes, *Sodium hydroxide, Recovery (Chemical), Cotton system processing, Dyehouse wastes.

Caustic soda recovery and reutilization procedures in cotton finishing plants result in annual savings exceeding 50 percent of the initial investment. These savings result even though it might be necessary to collect, evaporate, filter, dialyze, re-evaporate, and treat the final wastes. Other beneficial side effects are increased yardage return and alleviation of water and air pollution. All plant officials are urged to have a caustic utilization survey made if considering such a system. (Lonon-North Carolina State)
W70-08736

HOLDING AND AERATION OF COTTON MILL FINISHING WASTE,
North Carolina State Univ., Raleigh.
Nelson L. Nemerow.
Proceedings, 5th Southern Municipal Industrial Waste Conference, Chapel Hill, North Carolina, 1956, p 149-156. 3 tab, 7 ref.

Descriptors: *Cotton, Waste waters, Pilot plant, Model studies, Biochemical oxygen demand, Aeration, Lagoons.
Identifiers: *Textile mill wastes, *Dyehouse wastes, Desizing wastes, Starch, Bleaching, Dyeing, pH, Kiering.

A pilot plant study was made of methods of treating waste water from a textile mill engaged in the processing of cotton fabrics. The wastes intering the effluent were from desizing, kiering, bleaching, and dyeing. The starch from the desizing step is the main source of BOD. (1) Ten hours of holding and 12 hours of aeration with pH control reduced BOD by 71-79 percent. (2) Twenty seven of holding alone reduced BOD by 56 percent and an additional 12 hours of aeration brought this to 75 percent. (3) Three hours of holding and 7 hours of aeration produced a reduction of 49 percent. (4) As holding time was reduced, more CO_2 for neutralization was required. (5) With no neutralization and a pH of 11.3 only 39 percent reduction was secured in 10 hours holding and 12 hours of aeration. (6) The pH dropped from 11.3 to 9.9 during aeration. (7) A bacterial count of 5

million was found even in highly alkaline waste water. (WorkeNorth Carolina State)
W70-08739

EFFLUENT PURIFICATION OF A BLEACHING AND DYEING PLANT,
Josef Wittman.
Melliand Textilberichte, Vol. 38, No. 6, p 679-680, June 1957. 3 fig.

Descriptors: *Chemical precipitation, Iron, *Aeration, Industrial wastes.
Identifiers: *Textile mill wastes, Bleaching, Dyeing, Dyestuffs.

The problems of treatment of industrial waste waters is discussed and a process is described for the treatment of waste waters from bleaching and dyeing. The process is based on the use of chemical precipitation by metallic iron in the form of waste filings which are stirred, with aeration, with the waste waters in a concrete-covered tank. (Livengood-North Carolina State)
W70-08741

FOR HOSIERY FINISHERS: WHY BIODEGRADABLE DETERGENTS HELP SOLVE SEWAGE DISPOSAL PROBLEMS,
Harry White.
Hosiery and Underwear, Vol. 49, No. 8, p 56-58 and 64, August, 1966. 2 fig.

Descriptors: *Biodegradation, Biochemical oxygen demand, Waste waters, *Detergents, Biological treatment, Sewage treatment.
Identifiers: *Textile mill wastes, *Hosiery dyeing, Dyehouse wastes.

The BOD, pH, volume, odor, and color determine treatment for the waste waters from hosiery dyehouses. Usually, if the effluents are discharged into a large municipal sewage-disposal system, no problems arise. But, smaller systems may not be able to handle the wastes. A case history in a small southern town is given. Nonionic detergents resist biodegradation . The river die-away test, the shake flask method, and the laboratory schal sewage plant system are three biological test useful in determining biodegradability. Although biodegradable detergents enhance sewage disposal, they do not eliminate all disposal problems. (Lonon-North Carolina State)
W70-08742

WASTE PROBLEMS ASSOCIATED WITH DYEING AND FINISHING OF SYNTHETIC FIBERS,
Du Pont de Nemours (E. I.) and Co., Wilmington, Del.
S. G. Turnbull, Jr.
Southern Water Resources and Pollution Control Conference, Vol. 5, p 170-178, April 1956. 4 tab, 10 ref.

Descriptors: *Biochemical oxygen demand, Waste waters, Adhesives, Fibers, Phenols, Carriers, Biological treatment, Cotton.
Identifiers: *Textile mill wastes, Starch, Gums, Sizes (Slashing), Dyeing, Warp sizes, Man made fibers, Carrier dyeing, Desizing wastes, Dyehouse wastes.

Starches and gums applied during the yarn slashing stage account for 50 percent of the BOD in waste waters from a conventional cotton finishing plant. The BOD can be significantly reduced by substituting synthetic sizes for natural gums and starches. Waste waters from the dyeing of hydrophilic fibers have BOD values similar to those from wool and cotton dyeing. Phenols must be removed or destroyed to avoid ruining the taste when the water is reused. Carriers used in dyeing hydrophobic fibers present special problems. Bacterial decomposition is recommended to eliminate these phenolic types. The trend in fabric finishing is away from the natural compounds which give high BOD. (Lonon-North Carolina State)
W70-08743

WASTE DISPOSAL: A GROWING HEADACHE,
Irving Teplitz.
Textile Bulletin, Vol. 90, No. 6, p 70-74, June, 1964. 2 fig, 24 ref.

Descriptors: *Waste water disposal, Biological treatment, Waste treatment, Iron compounds, Lime, Trickling filters, Chemical precipitation.
Identifiers: *Textile mill wastes, Chemical treatment, Alum, Ferrous compounds.

The legal aspects of industrial wastes disposal can no longer be ignored. Textile wastes, e.g., floating matter, settleable suspended matter, colloidal impurities, acids and bases, and dyes, must be removed from plant effluents. Biological waste treatment is usually preferred because of cheaper operating costs. Often prevention eliminates the need for waste treatment facilities. Chemical treatment may involve the use of alum, iron or lime, ferrous sulfate and lime, ferric sulfate and lime, chlorinated ferrous sulfate, ferric chloride, ferrous chloride, lime alone, or sulfuric acid and sulfur dioxide. Biological treatment may include lagoons, activated sludge, trickling filters, hi-lo activated sludge, or the Zimmerman Process. Alkyl arylsulfonates, wool grease, and other special wastes present unique problems. (Lonon-North Carolina State)
W70-08744

BIOLOGICAL TREATMENT OF WOOL SPINNERY WASTE,
Fermentation Research Inst.
Masao Tanaka, Michio Dazai, Yorikazu Sonoda, Michiaki Sato, and Itideo Ono.
Kogyo Kagaku Zasshi (Journal of the Chemical Society of Japan, Industrial Chemistry Section) Vol. 67, No. 5, May 1964, p770-776.

Descriptors: *Biological treatment, Methane bacteria, Waste storage, Activated sludge, Waste water, Biochemical oxygen demand, Suspended load.
Identifiers: *Textile mill wastes, *Wool wastes, Dyeing, Wool, Wool grease.

Laboratory and pilot plant tests of wool spinning waste treatment were conducted. The wastes are treated by thermophilic methane fermentation. The digestive fluid from the fermentation step and other wastes are mixed in a lagoon. Then, the effluents are treated by the activated sludge process. BOD, grease content and suspended solid levels are satisfactory after this treatment. (Lonon-North Carolina State)
W70-08745

TEXTILE WASTE TREATMENT: WHAT TO DO ABOUT IT,
Cannon Mills Co., Kannapolis, N.C.
J. L. Brown.
Mechanical Engineering, Vol. 82, No. 6, p100, June 1960.

Descriptors: *Treatment facilities, Domestic wastes.
Identifiers: *Textile mill wastes, Sodium hydroxide, Starch, *Slashing wastes, *Bleaching wastes.

The equipment and techniques used at the Kannapolis, North Carolina mills of Cannon Mills are described. Wastes being treated consist of domestic sewage from the mills and mill village and certain wastes from the bleachery and slasher rooms (chiefly starch) and a 3 percent caustic solution used as a cleaning agents. A two-year study showed that treatment could best be effected if the wastes were segregrated at the bleachery and piped separately to the treatment plant. The starch was treated immediately, while the caustic was treated on a seven-day basis. The following units are used in treatment: a caustic storage lagoon, primary clarifiers, trickling filters, secondary clarifiers, a chlorine contact tank, sludge digesters, and vacuum filtration of sludge. Modifications in the system since its inception to improve efficiency are described. (Dandridge-North Carolina State)
W70-08746

PHYSICOCHEMICAL CHARACTERISTICS OF RESIDUAL WATERS AND TREATMENT EXPERIMENTS AT A COMPLEX TEXTILE MANUFACTURER,
Ministry of Light Industry, Bucharest (Rumania). Central Lab.
Maria Rusanovschi, Elena Iliescu, and Bathia Zilberstein.
Industria Textila (Bucharest, 17, (3), p160-165, 1966.

Descriptors: Biochemical oxygen demand, Hydrogen sulfide, Coagulation, Absorption, Chemical precipitation.
Identifiers: *Felt manufacturing plant, *Felt, Wool, Dyestuffs, Dyehouse wastes, Chromium compounds.

Studies were made on residual waters coming from a felt manufacturing plant. The total volume of residual waters in 5,000-6,000 m. 3/24 hrs. and contains large amounts of vegetal, animal, and synthetic materials. The water from the preliminary treatments of the wool are dark colored, contain suspended matter and fats, and have an alkaline reaction. They represent 1.3 percent of the total residual waters, but being the dirtiest they influence the total effluent. They analyze: pH 8.5-10, H2S 42.5-56.1 mg./l., KMn04 index 3700-4100, and B.O.D. (5-day) 1200-1500 mg./l., total fats 1.9-2.8g./l. The finishing waters contain dye residues, inorg. salts, detergents, H2S, and chromium compounds. The waters from the dyeing operation represent 57.6 percent of the total residual water; their characteristics are: pH 7.5, dark in color, H2S 23.4 mg./l., suspended matter (cellulose, short wool fibers) 354 mg./l., and pocess a low KMn04 index and low B.O.D. (5-day). The chemical methods for the treatment of the total residual water are coagulation and absorption. For coagulation, the following were used: (a) FeS04, (b) Al2 (S04)3 (c) FeCl3, (d) CaO, and (e) H2So4. For good results, the optimum amount of (a) = 1000-15000 and for (d) = 700-1000 mg./l. The sludge resulting from the treatment contains 58 percent inorg. matter: N 1.4-2.0, K as K20 3.5-6.3, and P as P205 0.1-0.25 percent. For adsorption, the following were used: activated charcoal, lignite slag, and residues of ion exchangers. The best results were obtained with activated charcoal. In general, absorption is too expensive to be used. (Livengood-North Carolina State)
W70-08747

COOLING TOWERS GET BIGGER AND BETTER AS WATER DEMANDS GROW.

Power Engineering, Vol 69, No 12, p 38-41, December 1965. 5 fig, 4 ref.

Descriptors: *Cooling towers, *Cooling water, *Thermal pollution, *Construction materials, Iron, Steel, Aluminum, Plastics.
Identifiers: *Redwood, *Service life, Natural draft, Mechanical draft.

The most important item in choosing a powerplant site is a source of cooling water. The problem of thermal pollution arises if a river cannot support the cooling load. Cooling towers, therefore, are needed to correct this problem. The two major types of cooling towers are the natural-draft and the mechanical draft. These towers are built of standard materials and coatings which are designed to provide satisfactory service life under normal conditions. Normal conditions include circulating water pH of between 6 and 8, chlorine content below 750 ppm, sodium bicarbonate content below 200 ppm, maximum temperature of 140F, and many other set standards. The standard materials include grey cast iron, nodular iron, steel, stainless steel, cast aluminum, wrought aluminum, copper alloys, redwood, Douglas fir plywood, asbestos cement, glass fiber reinforced polyester, resins, polypropylene, high density polyethylene, and many miscellaneous materials. If the standard materials are placed under abnormal conditions, special fasteners or heavy duty coatings may be required. (Osborne-Vanderbilt)
W70-08830

WORLD'S LARGEST HYPERBOLIC TOWER COOLS A POWER PLANT.

Engineering News-Record, Vol. 178, No. 5, p 58-59, May 4, 1967. 2 fig.

Descriptors: *Cooling towers, *Powerplants, Cooling water, Turbines, Condenser, Cast-in-place structures, Humidity, Water temperature, Thermal pollution, Thermal powerplants.
Identifiers: *Monongahela River, Cross-flow, Natural draft.

The world's largest cooling tower - a 370-ft-high, 378-ft-diameter, hyperbolic concrete shell - cools 360 million gallons of water per day for the new 130 million dollar, Fort Martin, W. Va., power plant. The two natural draft cooling towers, combining a cross-flow cooling system with a hyperbolic natural draft air flow system, is the most suitable and economic type for the large quantities of cooling water required. Each tower will be capable of cooling 250,000 gallons per minute from 114F down to 90F. The towers, according to Marley, are built to withstand a 30 psf surface load or a 100 mile per hour wind. To achieve this, each shell is supported on 70-ft-long precast concrete X-frame columns. In building the towers, Marley used specially designed steel form panels and platforms, which hange from previously placed concrete lifts, eliminating the need for conventional scaffolding. The reasons for the giant dimensions were to prevent fogging along the Monongahela River and to guard against a discharge of 720 million gallons of heated water a day. (Osborne-Vanderbilt)
W70-08837

WASTE WATER DISPOSAL ENHANCES AN AREA ECOLOGY,
Campbell Soup Co., Napoleon, Ohio.
G. Marvin Shutt.
Industrial Water Engineering, Vol 7, No 3, p 18-22, March 1970.

Descriptors: *Waste water treatment, Biochemical oxygen demand, Design, Economic efficiency, Microorganisms, Hydraulics, Slopes, Texas, Paris (Texas).

The development of the overland-flow technique of waste water treatment and disposal which won for Campbell Soup Co. the Sports Foundation's in 1969 Gold Medal Award for Best Single Plant Program in industrial water pollution abatement was presented. Plant waste water originated from two main sources: the cooling area and the vegetable washing area. The plant's waste water containing suspended and dissolved organic impurities - 550-900 ppm of BOD - was sprayed along the top of the watershed by conventional irrigation sprinklers. As it percolated through dense vegetative sod to the soil's surface the waste water left behind most of the suspended solids and it trickled downhill the dissolved impurities were subjected by soil microorganisms to biological degradation. Purified water collects at the terrace and flows to the receiving stream via prepared waterways. A study of underlying reasons for performance was prompted in 1968 and design parameters for increased capacity or efficiency of the existing system were developed. Four test sites comprising ten acres of the Paris, Texas cannery field were subjected to intensive scrutiny. Microorganisms activity, hydraulic loading, degree of slope and length of slope were the desired design parameters developed. A list of landmarks in the development of the program was given. The results of the two-year research effort was significant in that it assures success with overland-flow waste treatment for other processors in other locations. (Kriss-Cornell)
W70-08850

WASTE WATER CHARGES IN GREAT BRITAIN,
West Hertfordshire Main Drainage Authority, Rickmansworth (England).
R. Wood.
Industrial Water Engineering, Vol 7, No 1, January 1970, p 27-29. 2 fig.

Descriptors: *Industrial wastes, *Waste treatment, *Optimum development plans, *Costs.
Identifiers: McGowan strength, *Process oxygen demand (POD).

A description of charges for industrial waste treatment in Great Britain which serve as a means of controlling the quality of the wastes discharged to the sewer, thereby controlling in turn the influent quality at the municipal treatment plant was given. The authorization of a charge for the service of sewerage and treatment at the minicipal treatment plant was initiated in 1937 and in 1961 the powers of the local authorities were extended. The policy described is that of the Institute of Water Pollution Control. An example given was that of the Mogden works of the Middlesex County Council where they first devised a volume/strength/solids formula which proved workable over a wide range of industrial wastes. To be effective the formula given stemed from an accurate calculation of the net costs of treatment at the municipal treatment plant. Rates themselves were included andadministrative overheads divided between capital and revenue expenditure. The WHMDA had operated a charging scheme based on this formula for a number of years. For non-inhibiting wastes, the use of the McGowan strength in volume/strength/solids formula assessed treatability to some extent. This was a calculation of the oxygen requirement for complete oxidation. Examples of the use of this method were given. 'Process oxygen demand' (POD) was suggested by Simpson as charges for industrial waste treatment based on requirements of the process to effect treatment. He indicated the possible breakdown of unit processes and his formula was shown. Control of industrial wastes could achieve optimum operating condition at the treatment plant and a minimum charge to both the general ratepayers and the industrial waste discharge achieved. (Kriss-Cornell)
W70-08853

WATER QUALITY IMPROVEMENT BY PHYSICAL AND CHEMICAL PROCESSES.
Texas Univ., Austin. Center for Research in Water Resources.

Water Resources Symposium No. 3, Center for Research in Water Resources, Austin, University of Texas Press, 1970. 448 p.

Descriptors: *Waste water treatment, *Water reuse, *Water quality, Standards, Tertiary, Wildlife, Estuaries, Agriculture, Design, Liquid wastes, Phosphorus, Ion exchange, Membrane processes, Sludge, Sludge disposal.
Identifiers: *Criteria, Sludge handling.

The most recent developments in the physical and chemical treatment of waste waters and handling and disposal of sludges were the subject of a special lecture series held in April 1969, at The University of Texas at Austin. The papers prepared for this third Water Resources Symposium sponsored by The University's Center for Research in Water Resources are presented. The content is particularly significant in the advanced treatment and technology now being considered for our expanding urban areas. The publication is divided into four sections. The first concerns itself with water quality requirements for reuse emphasizing criteria, objectives, and general water requirements, reuse of water by fisheries and wildlife facilities using both fresh water and estuarian systems. Problems of municipal reuse are described depicting actual plant operations. The second deals with functional designs related to the removal of settleable and suspended solids both in America and Europe. The third presents functional designs related to chemical treatment of liquid wastes. Implications are evaluated. Both theoritical discussions and practical applications are provided. And the forth treats of functional designs related to sludge separation and analysis of general sludge characteristics, thickining, sludge filtration and sludge conditioning, centrifugation, and disposal of sludge on land. (For individual papers see W70-08865 thru W70-08895). (Hancuff-Texas)
W70-08864

NATIONAL WATER QUALITY CRITERIA AN OBJECTIVES,
Federal Water Pollution Control Administration
Washington, D.C.
Joe G. Moore, Jr.
In: Water Quality Improvement by Physical an Chemical Processes, University of Texas Press Austin, 1970, p 3-9.

Descriptors: *Water quality, *Standards, Wate Quality Act, Legislation, Federal government State governments.
Identifiers: *Criteria, Objectives, Responsibility Agencies, Inforcement.

The federal program setting water quality standards, some of the assumptions which have been made and experience which has been gained, the impact of this program on State Water Pollution Control programs, and general ideas on the subject of water quality standards are discussed. The Water Quality Act stipulated that the states at their option had the first opportunity to establish standards and gave them until June 30, 1967, to do so. These standards then became subject to review and approval as federal standards by the Secretary of the Interior. After that date the Act permitted the Secretary of the Interior to establish standards directly. The Act does prescribe the mode of standard setting that emphasized federal-state cooperation, and this provision had important consequences. An unprecidented amount of state activity in water pollution control was caused by the inclusion of a financial bonus tagged to waste water treatment works construction grants for states which had established standards. Two basic concerns of FWPCA are (1) the standards be practical and forceful and (2) they reflect natural conditions when possible. The standards as of March 1969, have been approved by 49 out of the 50 states. Only in the state of Iowa does disagreement as to the degree of treatment persist. Several kinds of criteria are found in the standards. Key numerical parameters are dissolved oxygen which range from 3.5 to 7 mg/l for protection of various aquatic life, pH with a general range of 6.5 to 8.5 determined by natural conditions, temperature where maximum limits are based on natural temperatures with permissible change from natural of not more than 5 deg F and coliform organisms for which the traditional public health limits have been applied. (See also W70-08864). (Hancuff-Texas)
W70-08865

GENERAL WATER QUALITY REQUIREMENTS,
Wisconsin Univ., Madison.
James E. Kerrigan, and Gerald A. Rohlich.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 10-15. 6 ref.

Descriptors: *Water quality, *Standards, Water Quality Act, Controls, Monitoring, Variability.
Identifiers: *Criteria, Requirements, FWPCA, Water uses.

Quality identifies the degree of excellence which a thing possesses. The fundamental point is that the assignment of a level of quality to water is relative depending upon the use for which the water is assigned. To evaluate the characteristics of water it is essential to know whether these characteristics have any detrimental effect on the assigned use. Thus pollution has come to mean the introduction or persistence of any material in the resource which interferes with alters, or destroys some beneficial use. In our society it is recommended that we develop criteria for domestic water supplies, recreation, agriculture, irrigation, fish and wildlife, industrial water and aesthetic uses. Each of these use areas is influenced individually by the presence and concentration of key water characteristics. For a parameter to be useful in the development, it must meet the following demands: (1) It should indicate whether the water has been adversely affected for some use. (2) Its measurement should be practical, reproducible and relatively accurate. (3) Its measurements taken at sufficient intervals

should identify the variability and give the statistical relevance of the parameter. (4) Its data should reflect the nature of its long-term variability. It is emphasized that the level of treatment required for the quantities of waste discharged allowable be dictated by the characteristics of the receiving waters and the effects imposed on these waters by the discharged rather than the use of a uniform effluent standard. (See also W70-08864). (Hancuff-Texas)
W70-08866

WATER QUALITY REQUIREMENTS FOR REUSE BY FISHERIES AND WILDLIFE,
Bureau of Sport Fisheries and Wildlife, Fort Collins, Colo.
Croswell Henderson.
In: Water Quality Improvement by Physical and Chemical Processes, Univ of Texas Press, Austin, 1970, p 16-23. 23 ref.

Descriptors: *Water reuse, *Standards, *Fisheries, *Wildlife, Water quality, Water resources, Sewage treatment, Waste water treatment, Recreation, Research and development, Toxicity.
Identifiers: *Criteria, Organisms.

The pollution situation today with respect to fish and wildlife is not particularly bright. The FWPCA published an annual report since 1960 entitled 'Pollution Caused Fish Kills.' The 1967 report published in 1968 shows over 11 million fish killed by pollution caused incidents reported from 40 states. Of the total number of fish, 71% reported killed by industrial wastes, 16% by agricultural wastes and 8% by municipal wastes, and the remainder by other causes. Of the 375 separate incidents reported 139 were caused by industrial wastes, 91 by municipal wastes, 90 by agricultural wastes. The major requisite to maintaining a fishery is to have an adequate quantity of water as well as a water of satisfactory quality at all times during the year. From the standpoint of fisheries, the primary objective by establishing water quality standards is to observe the survival, reproduction and well-being of aquatic organisms. Standards must be based on a thorough knowledge of the environmental requirements of those organisms that must be protected. A summary is presented of the key criteria and recommendations considered to be satisfactory for aquatic life and wildlife. These contain such variables as dissolved materials which include toxic materials, pH, alkalinity, acidity, temperature, dissolved oxygen, carbon dioxide, oil, turbidity, settleable material, color, floating material, tanking substances, radionuclides, plant nutrients and toxic substances. These variables are evaluated for aquatic organisms as well as water fowl and other wildlife. (See also W70-08864). (Hancuff-Texas)
W70-08867

FISHERIES AND WILDLIFE IN THE MARINE HABITAT AND SOME RELATED WATER QUALITY REQUIREMENTS,
Texas Parks and Wildlife Dept., Rockport.
Earnest G. Simmons.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 24-30. 39 ref.

Descriptors: *Water quality, *Fisheries, *Wildlife, *Estuaries, Salinity, Temperature, Dissolved oxygen, Pollutants, Physical properties.
Identifiers: *Marine environment.

A variety of definitions is given for the word 'estuary,' with the final most generally accepted definition as: an estuary is a semi-enclosed coastal body of water having a free connection with the open sea and within which the sea water is measurably diluted with fresh water deriving from land drainage. The importance of estuaries are emphasized from a standpoint of being indispensable to water fowl, pelicans, quail, cranes, eagles, osprey, and shore wading birds. In addition they are important as nursery grounds for such fish as spotted sea trout, channel bass, and red fish. Estuaries are very important from the standpoint of spawning grounds. Destruction of the estuaries would eliminate or adversely affect commercial shrimp, oysters, blue crabs, menhaden, red fish, and many other forms of marine life vital to the food chain. The factors discussed effecting wildlife in estuaries are salinity, temperature, dissolved oxygen, pesticides, and other pollutants, the latter being mostly industrial. The first three of the aforementioned has a wide range of acceptability; however, the last two categories present problems in determining the exact defects of such complex problems. (See also W70-08864). (Hancuff-Texas)
W70-08868

MUNICIPAL REUSE OF WATER,
National Inst. for Water Research, Pretoria (South Africa).
G. J. Stander, and L. R. J. van Vuuren.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 31-48. 19 fig, 3 tab, 7 ref.

Descriptors: *Water reuse, *Tertiary treatment, *Domestic water, Sewage treatment, Waste water treatment, Water supply, Reclamation, Activated carbon, Filtration, Chlorination.
Identifiers: *Pretoria (South Africa), *Criteria, Fractionation, Flotation, Ammonia stripping.

The return flows which are available at sewage purification plants serving metropolitan areas in South Africa constitute a major proportion of the fresh water intake. The optimization of municipal reuse requires a critical appraisal of a number of important factors. For example, whereas the quality of secondary purified sewage effluents in South Africa is generally suitable for cooling water and limited industrial use, advanced purification is required for domestic quality water for general distribution. A comparison of the quality of reclaimed water with the national standards for drinking water is tabulated. The criteria is broken into four main parts; (1) potability, dealing mostly with metallic ions, (2) health hazards dealing with potentially dangerous ions, (3) toxicity covering most of the heavy metals, and (4) chemical indicators of pollution as COD, BOD total nitrogen, etc. A fullscale effluent reclamation plant which is today supplying 1/3 of the water demand for the city of Windhoek utilized algae ponds and flocculation/flotation process. The quality of the finished water meets the requirements prescribed by the World Health Organization. Due to encouraging results obtained with the pilot plant study at Pretoria Municipal Sewage Disposal Works, a 1 mgd demonstration plant is being erected. One of the objectives of this experiment is to demonstrate to the public the possible reclamation of sewage effluents for domestic use and elimination of public prejudice and aesthetic objections. (See also W70-08864). (Hancuff-Texas)
W70-08869

HEALTH ASPECTS OF WASTE WATER REUSE,
Public Health Service, Dallas, Tex.
Charles W. Northington, Shih L. Chang, and Leland J. McCabe.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 49-56. 22 ref.

Descriptors: *Public health, *Water reuse, Research and development, *Infections, Toxicity, Tertiary treatment, Sewage treatment, Waste water treatment.
Identifiers: *Carcenogens.

A brief history is presented of the development of waste water reuse for domestic water supply and the need for waste water reuse research is emphasized. If the reuse of waste water for drinking purposes has really arrived there is a gross imbalance of the federal effort to study the health aspects. As an illustration the budget allowed for advanced waste treatment research approximately 8 million dollars in the fiscal year 1969 as opposed to the entire water hygiene research program of the Public Health Service for the same year of $537,800. The reuse of waste water is discussed from the standpoint of biological acceptibility as depicted by pathogens and parasites. The importance of consideration of low-level transmission of viruses by water is examplified by a 50 mgd supply which has a 99.99% reduction of virus typically reducing the count to 1 unit per 50 gallons; assuming 0.2% of the total supply is consumed as drinking water about 2,000 virus units will be swallowed daily by the people supplied with this water. Similar examples are given for bacterial infections, protozoan infections, and nematode and helminth infections. In addition studies are needed to determine the chronic toxicity, carcegonic effects, sex hormone effects and radioactive effects of waste water reuse. (See also W70-08864). (Hancuff-Texas)
W70-08870

WATER QUALITY REQUIREMENTS FOR RECREATION,
Wisconsin Univ., Green Bay.
Edward H. Storey, and Robert B. Ditton.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 57-63. 1 fig, 17 ref.

Descriptors: *Water quality, *Recreations, Ranges, Water reuse, Tertiary treatment, Waste water treatment.
Identifiers: *Threshold, *Criteria, *Variables, Requirements.

Recreation usage is the most rapidly growing demand on water. Studies conducted by the Outdoor Recreation Resource Review Commission in 1960 revealed that 40% of outdoor recreation participants favored water-based recreation activities over any others. Subsequent studies conducted by the Bureau of Outdoor Recreation have revealed that water-based activities are increasing sharply as evidenced by a 12% increase in fishing, an 18% increase in boating and a 15% increase in swimming during the half decade from 1960-1965, while population increased only 8%. Paradoxically as the nation's recreational demands upon water have increased, the suitability of the nation's resources to support water recreation activity has steadily deteriorated. The water quality variables effecting the ability to support or produce recreation include biological, chemical, and physical properties, each of which may induce a variety of psychological reactions. The psychological variables are broken into three categories: (1) The effective range is that quality of water which is not polluted sufficiently to influence the suitability of water for a specific recreational use. (2) The threshold is the minimum level at which water quality necessary to support a specific recreation. (3) The affected range is that range of quality within which the suitability of water for a specific use is deleteriously affected. Various references are cited in such areas as benefit cost analysis for water quality goals, requirements for body contact, recreational activities, and aesthetic acceptance of water oriented recreation. (See also W70-08864). (Hancuff-Texas)
W70-08871

REUSE OF WATER FOR THE PRODUCTION OF AGRICULTURE CROPS,
Texas Tech Univ., Lubbock.
Clark Harvey, Chester C. Jaynes, and Gerald W. Thomas.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 64-69. 1 tab, 20 ref.

Descriptors: *Water quality, *Productivity, *Agriculture, *Crops, Water reuse, Industrial waste, Surface runoff, Recharge, Lakes, Sewage treatment, Effluents.
Identifiers: *Criteria.

Sources of reuse water for the production of agricultural crops is reported for sewage effluent, industrial plant wastes, and surface runoff. The amount of sewage effluent discharged from municipal treatment plants in the United States on an average day has been estimated at 65,000 acre feet. Several examples are cited in which increased crop production was realized due to irrigation with sewage effluent for example grain sorghum yields were improved by sewage effluent (4,494 lbs/acre) over well water (3,572 lbs/acre) when each was used without additional nitrogen. Problem constituents of sewage effluents that may build up toxic levels in soils are dissolved solids, suspended solids, acids and metallic elements. Industrial waste is another source of reuse water that may be used in the production of agriculture crops. Examples are given of milk wastes, pulp mill and paper making wastes and paper board mill wastes. The southern High Plains of Texas constitute one of the major irrigated agriculture areas of the world. The Ogallala formation reservoir is hydrologically isolated and recharge can only come from precipitation. The High Plains area is characterized by numerous shallow undrained depressions or playas. Artificial groundwater recharge can be accomplished by injecting water collected in playa lakes into a multipurpose well. Groundwater recharge can conserve 75-80% of the water in the playa lake as compared with the 90% normally lost through evaporation. (See also W70-08864). (Hancuff-Texas)
W70-08872

TREATMENT OF WATER FOR BOILING AND COOLING PURPOSES,
Engineering-Science Inc., Arcadia, Calif.
Montague Blundon.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 70-79. 7 fig, 17 ref.

Descriptors: *Water reuse, *Water treatment, *Waste water treatment, *Boilers, Ion exchange, Water softening, Reverse osmosis, Electrodialysis, Cooling water, Filtration, Detergents, Alkylbenzene sulfonate.
Identifiers: Condensate, Removal.

To be suitable for conventional boiler make up, effluents from treatment processes, either municipal or industrial, must go through pretreatment for removal of troublesome constituents. Ammonia is corrosive to copper and copper alloys, and a number of treatment processes are given for its removal. Problems of phosphates stem from the possibility of the presence of orthophosphates reacting with residual hardness to form a hard scale. Household and industrial detergents may cause considerable problems with foaming, carry over and film boiling as well as fowling of ion exchange resins. A typical flow diagram of make-up treatment is presented and includes a cationic exchanger, degasifier, anion exchanger, and a mixed bed of cation and anion exchange material. Two other advanced processes that will undoubtedly soon find use in boiler feed water treatment include reverse osmosis, and electrodialysis. Evaporators are still a significant factor in feed water treatment field. Multi-stage flash evaporators produce excellent feed water. A short discussion is presented on condensate treatment. (See also W70-08864). (Hancuff-Texas)
W70-08873

UNITED STATES PRACTICES IN SEDIMENTATION OF SEWAGE AND WASTE SOLIDS,
Rex Chainbelt, Inc., Milwaukee, Wis.
Anthony Geinopolos, and William J. Katz.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 83-91. 5 fig, 18 ref.

Descriptors: *Sedimentation, *Settling basin, *Design, Equipment.
Identifiers: *Zone, Suspended solids, Loading, Retention time.

Fundamental to the process of sedimentation is the consideration of the character of suspended matter to be removed and the hydraulics of the basin in which solid-liquid separation is to be achieved. For example the suspended matter to be removed may range from discrete particles to flocculant materials may be settleable or floatable and may be present from low to high concentrations. Separation properties of solids therefore will depend on their type and character. Added to these difficulties is the effect hydraulic conditions have on solids removal by sedimentation basins. Included in a discussion of clarification equipment design is the size and shape of the basin, the inlet and outlet configurations, surface and solids loading, and hydraulic effectiveness as controlled by turbulence and short circuiting. An example of design is presented based on a complete examination of two criteria: overflow rate, and solids loading. (See also W70-08864). (Hancuff-Texas)
W70-08874

EUROPEAN PRACTICES IN SEDIMENTATION,
Emschergenossenschaft, Essen (West Germany).
Karl-Heinz Kalbskopf.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 92-103. 21 fig, 13 ref.

Descriptors: *Settling basins, *Performance, *Equipment, *Sedimentation, Flocculation, Efficiencies, Design, Costs.
Identifiers: *Loading, Europe, Practices.

A simple and economical method of separating settleable solids from liquids is of paramount operational importance to all mechanical, chemical, and biological processes applied in treating sewage. Over the years a great many different types of sedimentation units have been developed. The usual design factors do not cover all the complex physical and chemical processes that may take place in tanks when sewage and its solid particles float through the system. Most of the design data used ar e operating parameters established empirically. In Europe it is common practice to design sedimentation tanks with a certain detention period. The detention period chosen for domestic sewage range from 0.5 to 2.5 hours for primary sedimentation and 1.5 to 4 hours for secondary sedimentation. It is of utmost importance to acknowledge the fact that a very high efficiency can be reached only if optimum tank proportions are chosen with regard to hydraulic conditions. The usual design data determining the volume of a tank are: (1) the overflow rate ranging from 0.5 to 1.5 meters per hour in horizontal and 2.5 meters per hour in vertical flow tanks; (2) the solids loading (3.5 kilograms per square meter.hour in horizontal float tanks up to 7.5 kg/sq meter.hour in vertical flow; (3) the mean flow velocity (0.8 to 1.5 cm/sec) and (4) weir rates (5 to 20 cu meters per meter hour). Important design values for final sedimentation tanks are presented which include sludge volume index as a decisive influencing factor on the permissable solids loading. (See also W70-08864). (Hancuff-Texas)
W70-08875

SAND AND DIATOMITE FILTRATION PRACTICES,
Iowa State Univ., Ames.
E. Robert Baumann, and Charles S. Oulman.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 104-131. 19 fig, 2 tab, 20 ref.

Descriptors: *Filtration, *Diatomaceous earth, *Sands, Operations, Variability, Design, Pre-treatment, Particle size, Filters, Coatings, Headloss.
Identifiers: Polyelectrolytes.

Theoretical and empirical techniques for predicting filter performance have been developed and perfected. It will be necessary for engineers to continue to base filter design on experience. Several guides are presented for engineers designing granular filters. (1) Influent rate control has ma distinct advantages over effluent rate control a variable declining rate system reduces headlo required for flow control. (2) Dual or multi-med filters can significantly lengthen the run a produce better water quality than a single mediu Coated filters may be used as secondary filtrati media for polishing the effluent from granular fi ters. (3) Water pre-treatment control has an impo tant effect on filtrate quality. Polyelectrolytes c improve effluent quality when added in very sma amounts to filter influent as it enters the filter bo But polyelectrolyte can not substitute for adequat control of coagulant dosage and pre-treatment. (4 Linear increase of headloss versus volume of fi trate should be the goal when filters are operated a a constant rate. Convex filtrate curves of headlo versus volume indicate surface rather than dept removal of solids and higher filtration rates may b needed. Concave filtrate curves of headloss versu volume indicate weak removal of solids and poten tial passage of turbidity during constant rate filtra tion. (See also W70-08864). (Hancuff-Texas)
W70-08876

FILTRATION AND MICROSTRAINING OF SECONDARY EFFLUENT,
Metropolitan Sanitary District of Greater Chicago Ill.
Bart T. Lynam, and Vinton W. Bacon.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 132-148. 16 fig, 1 tab, 10 ref.

Descriptors: *Filtration, *Tertiary treatment, *Evaluation, *Efficiencies, Headloss, Sands, Waste water treatment, Sewage treatment.
Identifiers: *Microstraining, Loadings, Suspended solids, Chicago (Ill).

A rational approach to the analysis of data relative to the performance of filtration devices in treating secondary activated sludge effluents to remove suspended solids is presented. In it should be considered suspended solids removal as a function of suspended loading in terms of lb/sq ft/day. This takes into account the parameters of hydraulic loading, in terms of gal/min/sq ft, solids input and the resultant effluent from the filtration process. A laboratory scale experiment is cited in which the conditions of filtration are 200 gal/sq ft/hr (3.3 gal/min/sq ft) 36 inches of commercial grade 7-14 sand, solids in the media of 0.9 lb/sq ft/day would apply within the constraint of a given sand type and operating head or when investigating a microstrainer the fabric size, operation of drum speed and head conditions. A comparison is presented between a sand filter and microstrainer. The cost of a 10 MGD plant is computed based on equivalent results and loading. A cost differential of 0.30 cents/1000 gal (2.4 cents for sand filtration and 2.76 cents for microstraining) is calculated. Microstrainers have advantage over sand filters in that there is a low hydraulic head and minimum space requirement. (See also W70-08864). (Hancuff-Texas)
W70-08877

HIGH-RATE SEDIMENTATION WITH THE TUBE CLARIFIER CONCEPT,
Neptune Microfloc Inc., Corvallis, Oreg.
Gordon Culp, and Walter Conley.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 149-166. 11 fig, 1 tab, 15 ref.

Descriptors: *Sedimentation, *Settling basins, *Tubes, *Filtration, Water treatment, Waste water treatment, Sewage treatment, Turbidity.
Identifiers: Tube-clarifier, Mixed media filter, Clarifiers, Theory, Polymers, Suspended solids.

Two basic settling tube systems are illustrated: the first is essentially horizontal, the second is steeply inclined. The essentially horizontal tube settler is used in conjunction with a filter and has its sludge removed during the back wash cycle of the filter at

which time the tubes are drained and the sludge carried to waste. The water drained from the tubes is replaced with the last portion of the filter backwash water thus no additional water is lost due to tube drainage and no mechanical sludge removal equipment is required. The steeply inclined tube settlers have continuous sludge removal achieved through gravity settling (if the angle is in excess of 45 deg). Practical applications for the tubes are described such as tertiary waste water treatment, and water treatment. Significant advantages are gained when considering hydraulic loadings. Considerably higher rates than permissible for conventional horizontal or upflow clarifiers are attained. Loading rates of 3 to 5 gallons per minute per square foot of tube entrance area are permissible while limits of 1 gallon per minute per square foot are common for conventional flow clarifiers. Mixed media filtration technology is also described. Configuration of the mixed media bed is such that more particles can be stored before backwashing is required. Installation of mixed media significantly increases the capacity of existing plants without changing their physical area. (See also W70-08864). (Hancuff-Texas)
W70-08878

HIGH-RATE FILTRATION OF INDUSTRIAL WASTES,
Ambionic Designs, Inc., New York.
Eugene J. Donovan, Jr.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 167-189. 19 fig, 2 tab, 5 ref.

Descriptors: *Filtration, *Industrial waste, *Waste water treatment, Design, Pilot plants, Headloss.
Identifiers: *Multi-media filters, Polymers, Suspended solids.

High-rate, deep-bed, in-depth filtration has distinct advantages over ordinary techniques of chemical coagulation and/or sedimentation for suspended solids removal. The required area for the treatment is substantially less. The plants are constructed in modules which can easily be repeated to fit any flow or design rate. Handling and feeding of bulk coagulant chemicals is eliminated and disposal of resultant sludges minimized. The filter design parameters are tabulated and include effluent quality, influent characteristics, suspended solids, temperature, media characteristics, filtration rate, headloss and polyelectrolytes. Pilot plant tests were made on a hot steel rolling mill discharge. A 2.3 mm sand and 5.1 mm anthracite medium were used separately and then combined and tested many times at various rates. The rate of 16 to 18 gal/min/sq ft was selected to produce an effluent less than 15 mg/l suspended solids consistently. A full-scale plant was designed with 2 feet of sand under 5 feet of anthracite. Comparisons between the 6-inch test filter and a full-scale 225 sq ft filter unit showed equivalent results. The filter is backwashed through an air scour for 5 minutes at 8 cfm/sq ft and then flushed with water for 10 minutes at 30 gal/min/sq ft. The cost of an industrial waste filtration installation will vary with the waste flows, design rate, type of installation, necessary backwash and sludge handling facilities and local cost factors. Rough costs are presented for gravity-type concrete construction filter plants with sludge thickener and vacuum filters included. (See also W70-08864). (Hancuff-Texas)
W70-08879

FLOTATION OF SEWAGE AND WASTE SOLIDS,
National Inst. for Water Research, Pretoria (South Africa).
G. J. Stander, and L. R. J. van Vuuren.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 190-199. 4 fig, 3 tab, 8 ref.

Descriptors: *Waste water treatment, *Flocculation, *Coagulation, Sewage treatment, Industrial wastes, Lime, Water softening, Chemicals.
Identifiers: *Flotation, Waste solids, Laboratory scale.

Flocculation/flotation is discussed as a unit process for separating coagulable suspended organic material from waste waters from fish and fishmeal processing plants, slaughter houses, primary clarified sewage, secondary effluents and oxidation and maturation pond effluents. Various flotation processes are essentially divided into two: dissolved air and dispersed air systems. The theory of dissolved air flotation provides for (1) adhesion of gas bubbles, (2) trapping of gas in floc structure as bubbles rise, (3) adsorption of gas bubbles as the floc structure is formed. Dispersed air systems are based on shearing actions of propellers or diffusion of gas through porous media to produce micro-air bubbles. For dissolved air systems bubbles of 80 microns usually exist while bubbles of 1000 microns are involved in dispersed air systems. In designing pilot scale flotation equipment laboratory investigation should first be conducted to establish criteria such as suitable flocculants, mixing conditions, aeration requirements and fluid velocities. Such surface active agents such as ABS or phospholipids appear to serve as activators for bubble attachment in flotation treatment of sewage and waste solids respectively. In the latter type of effluent sulfuric acid was most effective as a coagulant whereas excess lime showed definite advantages in treating sewage effluents. In laboratory scale investigations reductions of up to 70% in COD were achieved using sulfuric acid as a coagulant in fish factory and abattoir effluents. Removal of organic load with a laboratory flotation unit is tabulated for primary clarified sewage maturation ponds, slaughter house wastes, pulp and paper mill effluent and fishmeal processing effluents. (See also W70-08864). (Hancuff-Texas)
W70-08880

INTERFACIAL PROPERTIES ON OILY WATER CLARIFICATION,
Esso Research and Engineering Co., Florham Park, N.J.
Gerald P. Canevari.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 200-216. 11 fig, 9 ref.

Descriptors: *Oil, *Industrial waste, *Separation techniques, *Interfaces, Industrial water, Surface tension, Skimming, Waste water treatment, Equipment, Electrical stability, Stabilization, Chemicals.
Identifiers: *Surface active agents, Electrical double layer.

In most liquid-liquid dispersions there is one of three steps of the separation process that will usually be limiting. In sequence these steps are dispersed droplet collision, coalescence and finally settling. Techniques of separation are mainly directed at preferentially enhancing one of these steps, thus the identification of the limiting step for a given dispersion is a convenient means of characterizing the waste and selecting an appropriate separation technique. The significance of the drop size in oily water clarification problems can be considered as influencing the controlling parameter which is rise rate. The effect of interfacial properties on the rise rate of dispersed droplets is discussed and an example is given considering a liquid air interface. The presence of surface active agents has a major effect on the interfacial properties and the resultant ease of separation. The molecular structure of a surfactant determines its behavior at the interface, that is, orientation, concentration, adsorption rate and adsorption affinity. Although orientation of the surfactant at the oil water interface cannot be discerned, indirect evidence of its orientation can be observed by means of a hydrofilled balance. Other physical properties of significance in discussing oil water separation are viscosity of the continuous or external phase, the density difference between the oil phase and the water phase and the droplet diameter which is strongly influenced by interfacial forces. The influences of such items as suspended solids and the electrical double layer are discussed. (See also W70-08864). (Hancuff-Texas)
W70-08881

COAGULATION IN WATER AND WASTE WATER TREATMENT,
North Carolina Univ., Chapel Hill.
Charles R. O'Melia.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 219-236. 4 fig, 30 ref.

Descriptors: *Coagulation, *Colloids, *Translocation, *Electrical stability, Waste water treatment, Water treatment, Chemical adsorption, Flocculation.
Identifiers: *Polymers, *Destabilization, Electrical double layer.

When considering the theory of the practice of coagulation it is important to distinguish between two separate and distinct steps: (1) The particles to be aggregated must be able to adhere to each other when brought into contact (destabilization step is brought about by chemical coagulants); (2) Destabilized particles must be transported or brought into contact to effect the formation of larger particles. Three mechanisms of colloid destabilization are presented and discussed in detail. Destabilization may be accomplished by an indifferent electrolyte through compression of the electric double layer surrounding the colloidal particle, it may occur through neutralization of the charge on the particle by the specific adsorption of a coagulant of opposite charge or it may occur through the formation of a bridge through colloidal particles of a polymeric molecule. Destabilization in most conventional water and waste water treatment processes is accomplished by polymers. These polymers may be added directly to the process, may be produced within the process from salts added to the system, or may be produced directly within the system from substances present in the waste water. A summary of some evidence for this opinion is presented. Intraparticle destabilization can be accomplished in several ways. Three mechanisms are presented: (1) contact by thermal motion, (2) contacts resulting from bulk fluid motion, (3) contacts from settling of the particles. (See also W70-08864). (Hancuff-Texas)
W70-08882

PHOSPHATE PRECIPITATION,
Harvard Univ., Cambridge, Mass.
James O. Leckie, and Werner Stumm.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 237-249. 7 fig, 3 tab, 21 ref.

Descriptors: *Chemistry of precipitation, *Phosphate, *Solubility, *Kinetics, Hydrogen ion concentration, Nutrients, Chemicals, Phase diagram, Chemical precipitation.
Identifiers: Stoichiometry, Solid phase.

The continuous precipitation of phosphate in treatment of waste is a dynamic process and most likely equilibrium conditions are not attained; however, equilibrium considerations can aid attempts to understand the mode of phosphate removal. Furthermore, equilibrium calculations provide boundary conditions towards which the system must proceed. Formulation of the stoichiometry of the chemical reaction defined the minimum requisite quantity of chemicals. The stoichiometry and pH dependence is illustrated through the use of several solubility diagrams for iron phosphate and aluminum phosphate. The precipitation of phosphate with iron and aluminum is very fast; however, the rate of removal is controlled by agglomeration of colloids and by settling. Many factors may catalyze or retard the rate of precipitation. Flouride, even in trace concentrations enhances the rate of precipitation; while organic substances may act as crystal poison. Thus phosphorus removal is probably the most expensive step in treatment of waste. Design factors for phosphate removal plants

need to be based on pilot plant scale studies. (See also W70g08864). (Hancuff-Texas)
W70-08883

CHEMICAL OXIDATION AND REDUCTION,
Planidro, Sao Paulo (Brazil).
Max Lothar Hess.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 250-257. 4 fig, 8 ref.

Descriptors: *Chemicals, *Oxidation-reduction potential, Oxidation, Reduction (Chemical), Waste water treatment, Sewage treatment.

The knowledge of the redox potentials is important when considering the automatic operation of chemical oxidation and reduction processes. The transfer of electrons from one compound to another results in different potentials that can be measured by means of a potentiometer. In this the potential of an inert electrode immersed in a solution is compared with the potential of a reference electrode. The potential of the so-called Normal Hydrogen Electrode or NHE is assumed to be 0. Since the NHE is not suitable for practical use, other reference electrodes are commonly adopted. When considering waste water treatment, even the cheapest reductants and oxidants represent a considerable expenditure. Too main measures of economy should be kept in mind. (1) Segrating the waste that ought to be chemically treated from the other waste streams and (2) Monitoring redox potentials for excess reagent indicators. Common oxidants are discussed such as oxygen, chlorine, chlorous compounds, ozone and nitrates. Common reductants such as ferrous sulfate, sulfur dioxide, hydrazene, and iron are also discussed. Examples of chemical oxidation of waste waters are given for cyanides, cannery wastes and phenols. Examples of chemical reduction of waste waters are given for chromates, and decolorization of some synthetic dyes. All oxidation and reduction operations should be monitored to avoid finishing with an excess of oxidant or reductant which could be detrimental to receiving waters. (See also W70-08864). (Hancuff-Texas)
W70-08884

ION EXCHANGE FOR INDUSTRIAL WATER,
Rohm and Haas Co., Philadelphia, Pa.
Jerome G. Gaffney, Robert Kunin, and Donald G. Downing.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970. p 258-293, 16 fig, 9 tab.

Descriptors: *Industrial water, *Ion exchange, *Water softening, *Water quality, Cation exchange, Anion exchange, Desalination, Waste water treatment, Acid mine water, Tertiary treatment.
Identifiers: *Deionization, Regeneration, Trouble shooting.

There are two basic applications of ion exchange to the treatment of water in industry: water softening and water deionization. A discussion is presented on various ion exchange materials for water softening, as well as ion exchange resins involving the use of both cationic and anionic exchange. The measurement and effects of sodium leakage through a deionizing unit is discussed in regard to effluent quality. Choice of exchange resins is determined by the quality of water desired and costs involved. Discussion is presented on the removal of the various constituents such as free mineral acidity, carbon dioxide, silica and other various chemical constituents. Water desalination and renovation is discussed for the treatment of brackish waters in the 500-300 mg/l salinity range. A recently developed desalination technique utilizing ion exchange resins is described for this process. A combined ion exchange and coagulation process for treating acid mine drainage waters has been developed resulting in an effluent suitable for industrial, agricultural, or domestic usages. A modification of the process for treating acid mine waters can be employed as a tertiary sewage treatment process. The cost for treating secondary sewage effluent is only $0.15 to $0.20/1000 gal. Problems in water use in the industrial field may be encountered in four essential areas: (1) equipment, (2) operation, (3) exchange resin, and (4) influent changes. The important facits of these catagories are presented with illustrations of the major problems in each. (See also W70-08864). (Hancuff-Texas)
W70-08885

EXPANDED BED ACTIVATED CARBON ADSORPTION SYSTEMS FOR WASTE WATER TREATMENT,
Michigan Univ., Ann Arbor; and FMC Corp., Princeton, N.J.
Walter J. Weber, Jr., Charles B. Hopkins, and Ralph Bloom, Jr.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970. p 294-311, 11 fig, 1 tab, 17 ref.

Descriptors: *Activated carbon, *Tertiary treatment, Pilot plants, Organic compounds, Waste water treatment, Efficiencies, Mathematical model, Filtration.
Identifiers: Expanded bed, Packed bed.

A study is made directed towards field evaluation of expanded bed adsorbers which have certain potential operating advantages over packed-bed adsorbers for treating solutions which contain suspended solids. Chlorinated secondary effluent was used for the study. Experimental programs consisted of a 100 day comparative study of packed-bed and expanded bed modes of operation using 10-inch diameter steel columns with a total carbon depth of 12 feet. Both unfiltered and filtered secondary effluents were tested in paralleled operations. The sewage was comprised of approximately 25% industrial wastes 75% domestic waste. Secondary effluent was fed directly into two of the four adsorbers, white filtered secondary effluent was fed to the other two. All systems were operated at a loading of 5 gal/min/sq ft (2.72 gal/min). Filtration of the secondary effluent was accomplished with a 38 inch diameter cylindrical tank containing a 9 inch layer of anthracite coal (effective size 0.59 mm) and a 9 inch bed of filter sand (effective size 0.62 mm). Results of the study are presented graphically in terms of total organic carbon removal and soluble organic carbon removal versus volume of water treated. An expanded bed system can produce more treated effluent than an equivalent pack-bed system because of less down time for carbon cleaning operation. The elimination of frequent carbon cleaning results in a savings in operating labor for the expanded bed. For a 10 MGD plant the cost reduction probably would be about 0.1 cents/1000 gal. Pumping cost differences would be about 0.2 cents/1000 gal. (See also W70-08864). (Hancuff-Texas)
W70-08886

REVERSE OSMOSIS DEVELOPMENTS,
Santa Rosa Medical Center, San Antonio, Tex.; and Texas Univ., Austin.
David L. Goff, and Earnest F. Gloyna.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970. p 312-326, 9 fig, 2 tab, 33 ref.

Descriptors: *Reverse osmosis, *Operations, *Membranes, *Membrane processes, History, Mathematical model, Design, Desalination, Waste water treatment, Tertiary treatment.
Identifiers: Systems, Transport equation.

A historical development of the phenomenon of semi-permeable membranes and osmosis beginning with Abbe Nollet's observations in 1748 is presented. Some of the advantageous features that reverse osmosis offers as a separation process include: (1) Low energy requirements since phase changes are not required to effect the separation, (2) Simple and flexible operation, (3) Compa plant size. The heart of the process is a semi-perm able membrane. Although improved membran are being developed the modified cellulose acet membranes have been forerunners in the reve osmosis process and have brought in process to t point where it merits practical consideration many water separation applications. A transpo equation is developed based on a Fickian diffusi process. The solute transport is accomplished adsorption, diffusion, desorption process with d fusion assumed the rate controlling step. Vario operational considerations are presented. Ti physical and chemical degradation limit the usef lifetime of the present day RO membranes to abo 6-12 months. Cost estimates for small brackis water reverse osmosis plants are presented. For a MGD plant the total costs including plant amortiz tion, membrane replacement, energy, operati and maintenance if $0.59/1000 gal. For the sam conditions a 10 MGD plant is $0.38/1000 gallon (See also W70-08864). (Hancuff-Texas)
W70-08887

THE APPLICATION OF MEMBRANES T SEWAGE AND WASTE TREATMENT,
Resource Engineering Associates Inc., Stamfor Conn.
Robert W. Okey.
In: Water Quality Improvement by Physical an Chemical Processes, University of Texas Press Austin, 1970. p 327-338, 8 fig, 6 tab, 11 ref.

Descriptors: *Membranes, *Waste water treat ment, *Sewage treatment, *Tertiary treatment, *R everse osmosis, *Membrane processes, Costs, In dustrial wastes, Pulp wastes.

Membrane filtration includes a broad range o separation processes such as filtration, ultra-filtra tion, hyper-filtration, micropore-filtration, diffu sion, and reverse osmosis. Generally, those processes defined as super-filtration, hyper-filtration, and micro-filtration or the like refer to processes in which discrete holes or pores exist in a filter media and the efficiency of this type of filtration depends entirely on the difference of size between the pores and the particles to be removed. The pores are generally in the order of 1000 to 100000 A and larger. Waste waters requiring treatment frequently have a broad range of contaminant size varying from ions to colloidal particles of up to 1000 to 10000 A in their maximum dimensions. Therefore, membranes employing both diffusive and pore flow have application in waste management. Most membrane systems are designed in a series-paralleled layout in which the dilute process stream passes through several parallel membrane blocks or housing. This concept derives from the face that direct onflow systems tend to foul badly. Operating characteristics are tabulated for an activated sludge membrane plant treating both raw sewage and secondary effluent. Extensive studies on the treatment of various pulping waste streams are discussed. In another extensive study of the removal of ions and organics (2000 mw) from secondary effluents the separation required a flux value of 5 to 15 gpfd and an over pressure of 100-500 psi. Total cost is estimated at $0.40/1000 ga for a 1 MGD facility and $0.30/1000 gal for a 10 MGD facility. (See also W70-08864). (Hancuff-Texas)
W70-08888

GENERAL SLUDGE CHARACTERISTICS,
Engineering-Science, Inc./Texas, Austin.
Davis L. Ford.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970. p 341-357.

Descriptors: *Sludge, *Sludge treatment, Sedimentation, Heat balance, Chemical properties, Vacuum drying, Centrifugation, Sewage treatment.
Identifiers: *Sludge characteristics, Thickening, Vacuum filter, Flotation, Specific resistance.

A tabulation of physical and chemical sludge characteristics as reported from various sources is summarized. Settleability of a sludge is discussed with emphasis placed on the limitations of the settling rate parameters. Specific resistance and compressibility coefficients are defined and these charactertistics are tabulated for various sludges. A partial tabulation of caloric heat value of sludges combined with moisture content and percentage volatile and inert material is given. Chemical analyses of sludges are presented to illustrate the potential usefulness as fertilizers. The concentration of sludge nitrogen, phosphorus and potash content as well as organic fraction indicate the fertilizer value. Sludges are also described with respect to unit process performance. Sludge concentration and dewatering processes of gravity thickening, vacuum filtration, centrifugation, and flotation are considered. (See also W70-08864). (Hancuff-Texas)
W70-08889

THICKENING,
Illinois Univ., Urbana.
Richard I. Dick.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970. p 358-369, 7 fig, 18 ref.

Descriptors: *Sludge, *Sludge treatment, *Sedimentation, *Basin, Sewage treatment, Activated sludge.
Identifiers: *Thickening, Waste activated sludge, Flotation, Loading.

Thickening is an important part of waste treatment systems because it accomplishes major sludge volume reductions at a low cost. Two basic types of thickeners are: gravity and flotation. Recent fundamental advances in thickening have related mostly to the gravitational type. The theoritical behavior of sludges is relatively well understood and convenient techniques are available for using knowledge of basic suspension settling properties for thickener design and for rational control of operation. Determining the required area and volume for thickening are interrelated. It is proposed that the area determination should be based on a settling characteristic of the suspension while volume determinations normally should be based on the need for storing sludge during periods when the solid feed rate exceeds the capacity of the thickener for passing solids. An illustrative problem is presented and sample calculations are made to determine the required area and volume for the thickening of 0.3 MGD of waste activated sludge from an initial 2000 mg/l to 2% solids by weight. (See also W70-08864). (Hancuff-Texas)
W70-08890

SLUDGE FILTRATION AND SLUDGE CONDITIONING,
Texas Univ., Austin.
Joseph F. Malina, Jr.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970. p 370-387, 13 fig, 4 tab, 17 ref.

Descriptors: *Sludge, *Sludge treatment, Filtration, Vacuum drying, Design, Sewage treatment, Waste water treatment, Acitvated sludge, Temperature.
Identifiers: *Vacuum filter, Sludge conditioning, Specific resistance.

The various factors which effect filtration of sludges can be catagorized in two major classes. The first characteristics of the sludge include: (1) shape and characteristics of solid particles in the sludge to be dewatered. (2) chemical composition of the sludge, organic or inorganic. (3) suspended solids content of the sludge (4) compressibility of solids in the sludge and (5) viscosity of filtrate and specific resistance of the sludge. The first four of these are fixed and very little can be done to alter these characteristics. However, the viscosity of a filtrate as well as the specific resistance of the sludge can be altered by properly conditioning the sludge. Various aspects of sludge conditioning are presented and the effect of such conditioners as fly ash, newsprint, polymers and ferric chloride on specific resistance are presented. Results of this investigation show pulp newsprint at doses of 100-125% of the dry weight of the solids reduces the specific resistance of the activated sludge to a level equivalent to the minimum obtained with a cationic polymer with ferric chloride as a sludge conditioner. The effect of temperature on specific resistance of activated sludge was shown to have the least effect when utilizing pulp newspaper. The second category which effects filtration is the characteristics of the sludge dewatering system which include: type of filter medium used, size of pores, effects of solids, filter medium support, drainage system, operating pressure, contact time and final solids content of the cake. (See also W70-08864). (Hancuff-Tex)
W70-08891

CENTRIFUGATION,
Weston (Roy F.), West Chester, Pa.
J. H. Daugherty, and D. N. Bibbo.
In: Water Quality Improvement by Physical and Chemical Process, University of Texas Press, Austin, 1970. p 388-393, 1 fig, 2 tab.

Descriptors: *Sludge, *Sludge treatment, *Centrifugation, *Specification, Waste water treatment, Sewage treatment, Performance, Design, Activated sludge.

The three types of most widely used centrifuges in the field of waste water treatment are solid bowl, disc, and basket. Each perform one of three functions: clarification, classification or separation. Clarification is the process of removing the solids from a slurry phase where either the supernatant liquid or the solids are to be recovered. Classification is the process of removing solid particles of specific size from a liquid phase. Separation is the process of splitting a liquid into two fractions. In all three processes a difference in density must exist for the application to be feasible. In waste water treatment primary interest is in clarification or the removal of solids from a sludge or slurry, thereby reducing the volume for easier disposal. Centrifuges have been used extensively in the dewatering of primary, secondary and combined sludge and for oil recovery, slime sludge dewatering and by-products recovery. The solid-bowl machine is generally best suited for dewatering the solids involved in primary clarification. Centrifuges operating on primary sludge and achieving greater than 90% solids recovery have a cake discharge with a solids content of about 20 to 25%. Suggestions are given for specifications and information which may be presented to the equipment manufacturers when selecting a centrifuge for a specific use. (See also W70-08864). (Hancuff-Texas)
W70-08892

DISPOSAL OF SLUDGE ON LAND,
Texas Univ., Austin.
Ben B. Ewing, and Richard I. Dick.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970. p 394-408. 4 fig, 6 tab, 33 ref.

Descriptors: *Sludge, *Sludge disposal, *Fertilizers, Operations, Chemical properties, Diseases, Nutrients, Heavy metals, Costs.
Identifiers: *Landfill, Nuisances.

Sludge disposal on land may be applied as undigested primary, as excess activated sludge, or as digested sludge. It may be applied as a liquid or it may be dewatered or dried. The land may be used simply as a site for stockpiling sludge for storage. Sludge has long been applied to land for land improvement using the humus and the nutrients in the sludge for soil conditioning. Recently interest has been sparked in use of land application of liquid sludge as a means of sludge treatment and disposal. This practice also used the water for irrigation. If land disposal is compared with other sludge treatment and disposal costs instead of considering sludge in economic competition with chemical fertilizers as a means of increasing a crop production, it becomes economically attractive. Chemical composition of sewage sludge is also tabulated being broken down into total nitrogen varying from 1.81 to 5.96% total phosphate P2O5 varying from 1.16 to 6.97% total soluble K2O varying from 0.29 to 0.56% and ash varying from 27.7 to 61.4%. Odors, flies, and aesthetic degradation of the neighborhood seem to be the complaints most often voiced. Various costs are given including costs of transportation of sludge from the city by railroad tank car, tank truck, pipeline. In addition the cost of sludge disposal by various methods is presented for land application of liquid, digested sludge, dewatered sludge to landfill, fertilizer production, incinerator ash to landfill. (See also W70-08864). (Hancuff-Texas)
W70-08893

INTERRELATIONSHIP AND SLUDGE SEPARATIONS,
Texas Univ., Austin.
James Barnard, and W. Wesley Eckenfelder, Jr.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970. p 409-420, 6 fig, 7 tab, 12 ref.

Descriptors: *Sludge, *Sludge disposal, Mathematical model, Dewatering, Centrifugation, Vacuum drying, Sewage treatment, Waste water treatment, Industrial wastes.
Identifiers: *Interrelationships, *Sludge handling, Flotation, Thickening, Loading, Vacuum filter.

Increasing urbanization and decreasing land availability is placing increasing emphasis on concentration and dewatering of sludges for incineration or local land disposal. In order to attain the lease-cost solution for sludge treatment and disposal the interrelationships between treatment alternatives are of prime importance. Mathematical process models can be employed to relate cost to unit size, unit size to quality of product, and thus generate an optimization procedure for sludge treatment. The characteristics of a sludge vary with both the source, i.e., industrial or municipal and with the treatment process employed, i.e., physical, chemical or biological. These variations dictate the choice of treatment sequence. The major sludge treatment units discussed for the handling of primary and secondary sludge include flotation thickener, gravity thickener, aerobic digester, anaerobic digester, centrifuge, vacuum filter, drying beds, incineration, and land fills. The economics of each unit in the sludge treatment sequence has some effect on or is itself effected by other treatment units. The thickening of sludges prior to dewatering in a vacuum filter or centrifuge to treatment in biological units or to barging or piping to disposal has perhaps the highest benefit to cost ratio of all the units. Mathematical models are developed for flotation thickening, gravity thickening, sludge dewatering, centrifugation, and vacuum filtration. (See also W70-08864). (Hancuff-Texas)
W70-08894

EUROPEAN PRACTICES IN SLUDGE DEGESTION AND DISPOSAL,
Wolfgang A. G. Vater.
In: Water Quality Improvement by Physical and Chemical Processes, University of Texas Press, Austin, 1970, p 421-436. 11 fig, 3 tab, 11 ref.

Descriptors: *Sludge, *Sludge disposal, *Sludge digestion, Costs, Performance, Centrifuge, Vacuum drying, Dewatering, Incineration.
Identifiers: *Europe, Drying beds, Sludge handling, Pasteurization, Thickening, Vacuum filter, Filter presses.

European practices in sludge dewatering and disposal are discussed considering those aspects which differ from methods presently used in the United States. The differences between European

and American sludge disposal practices are primarily the result of cost differences. Power costs for municipal utilities is 2.5 cents/kw hr, current self-generated from digester gas 1.2 cents/kw3hr, fuei oil $0.10/gal, construction and installation costs for digesters is approximately $50/m3 and labor is about $4000/yr. Pasteurization prior to use on the soil is required if the sludge is to be used for improvement of the soil. Composting with refuse in which sufficient self-heating is generated is considered an effective heating of the liquid. Most sludge thickeners are tanks with circular cross sections. If they are not equipped with the scrapers the bottom is funnel shaped with sludge removal at the deepest point. Continuous decanter centrifuges are most commonly used. If no chemicals are added the recovery is 40-70% of solids from the raw sludge. The average vacuum filter rate is about 5 gal/sq ft and under favorable conditions up to 7.5 gal/sq ft for solids content of 10%. Of all available mechanical sludge dewatering equipment filter presses yield the greater possible cake solids content. The average performance is about 1 to 2.5 gal/sq ft with solids content of 10% and cake solids content of 40-60%. Sludge incineration yields the smallest possible final volume of any mechanical sludge handling method. Incinerators of the multiple hearth furnace and fluidized bed type are discussed. (See also W70-08864). (Hancuff-Texas)
W70-08895

THE UTILIZATION OF THIOCYANATE BY A HETEROTROPHIC BACTERIUM,
University Coll. of South Wales and Monmouthshire, Cardiff.
D. A. Stafford, and A. G. Gallely.
Journal General Microbiology, 55, Part 1, p 285-289, 1969. 3 fig, 8 ref.

Descriptors: *Activated sludge, *Biodegradation, *Incubation, *Isolation, *Assay, Dentrification, Inhibition, Phenol, Nitrogen.
Identifiers: *Autotrophs, Sterilization, Pseudomonad, Cellular nitrogen, Thiobacilli.

A heteorotrphic bacterium is isolated by plating out on a solid thiobacillus-enrichment medium. Characteristics of the organism given include: (1) rapid positive result in the oxidase test utilizing denitrification as an anaerobic respiratory mechanism. (2) no growth took place on nutrient agar at 4 over a period of ten days. (3) pigment is not produced under any conditions of growth. (4) the organism used thiocyanate as sole source of cellular nitrogen and sulfur. In the presence of excess thiocyanate, growth stopped suddenly whenever the carbon and energy source were exhausted. The organism fits the definition of pseudomonad. Characteristic features of the organism are its rough and smooth colonial variations. The potential use of the organism in the biological treatment of effluents is brought out by its ability to metabolize both phenol and thiocyanate simultaneously. (Radhakrishnan-Texas)
W70-08896

SEWAGE TREATMENT PLANTS,
Nebraska Univ., Lincoln.
Leon S. Directo.
Water and Sewage Works, Vol 116, No. 8, Aug 1969, p 289-296. 7 fig, 5 tab.

Descriptors: *Waste water treatment, *Sewage treatment, *Plants, *Organic loading, Biochemical oxygen demand, Trickling filter, Operation, Efficiency, Performance, Ponds, Stabilization, Lagoons, Sampling, Nebraska.
Identifiers: *Hydraulic loading, *Suspended solids, Aerated lagoon, Recommendations.

The purpose of the paper is to determine and compare organic and hydraulic loadings on each of the sewage plant components (selected in Nebraska) with design loadings and to evaluate the removal efficiencies of the plant components in terms of BOD and suspended solids (SS) and evaluate general operation of each treatment system. The evaluation program consists of three phases namely: preliminary office planning, field inspection, and actual field sampling and testing. A particular plant, plant A is discussed for its inability to produce a satisfactory effluent. The plant is being loaded with an organic load (from cheese factory) of about 4 to 5 times the design value. Alternative methods are recommended to eliminate the inefficiency. In the case of another plant, plant B, the loadings were found to be 50% of the designed value. The data obtained reflects climatic condition existing at the time of sampling. As regards plant C, which consists of aerated lagoon followed by stabilization pond, the overall removal efficiency was about 88% for BOD and 65.1% for suspended solids. For plant D a low-rate trickling filter, both hydraulic and organic loadings were below the design value. Plant E, a high-rate single stage trickling filter had overall removal efficiency of 85% for BOD and 99% for SS. (Shankar-Texas)
W70-08897

A STANDARDIZED PROCEDURE FOR THE DETERMINATION OF DEHYDROGENASE ACTIVITY IN SAMPLES FROM ANAEROBIC TREATMENT SYSTEMS,
Middle East Technical Univ., Ankara (Turkey).
G. Lenhard.
Water Research, Vol 2, No 2, p 161-167, February 1968. 7 fig, 1 tab, 19 ref.

Descriptors: *Denitrification, *Anaerobic digestion, Temperature, Sludge, Digestion, Activated sludge, Waste water treatment, Sewage treatment.
Identifiers: *Dehydrogenase activity, Biochemical process, Reaction time, TTC concentration, Standardized method.

The applicability was studied of the dehydrogenase activity method for assessment of anaerobic treatment systems activity. The biochemically active sludge used for the tests was taken from two anaerobic digesters, one in which the denitrification activity was high. The results showed that (a) the optimum pH is identical with that for aerobic activated sludge systems, (b) linearity exists between dehydrogenase activity and sample quantity on the one hand and time on the other for both strongly and weakly active sludges tested, (c) the optimum temperature is 37C which is the same in aerobic systems, and (d) the optimal, final triphenyl tetrazolium chloride (TTC) concentration is 0.1%. The dehydrogenase activity method originally developed for soils and solid waste materials is also applicable to the study of anaerobic treatment systems like the one demonstrated. In special cases of anaerobic fermentation, care should be taken to insure that triphenyl formazan (TF) formation is biochemical by testing for factors characteristic of enzyme kinetics. (Shankar-Texas)
W70-08899

THE RELATION BETWEEN SLUDGE VOLUME INDEX AND SLUDGE CONTENT IN THE ACTIVATED SLUDGE PROCESS,
Instituut voor Gezondheidstechniek TNO, Delft (Netherlands).
J. A. Somers.
Water Research, Vol 2, No 5, p 563-573, May 1968. 7 fig, 2 tab, 5 ref.

Descriptors: *Sludge, *Activated sludge, Sedimentation, *Sludge treatment, Sewage treatment, Waste water treatment.
Identifiers: *Sludge volume index, *Sludge content, Variation, Bulking sludge, Vessel diameter, Grain diameter, Flow velocity, Pore volume.

To characterize the sedimentation properties of activated sludge in the activated sludge treatment process, the determination of the sludge volume index (SVI) is important. Experiments were conducted in the oxidation ditch at Oudewater. A slow rise of SVI 45-55 to 70-90 was noted during the years 1962-1964. It is felt that the wide divergence may be due to inhomogeneities in the settling sludge mass and varying sludge qualities in t period of two years. Experimental methods we adopted to determine the SVI by artificially varyi sludge contents. The results from Oudewat showed that SVI increases as the sludge content i creases. However, for the highest sludge content lower SVI was noted. Sludge from Sancta Ma (plant with bulking sludge) showed a differe result. In this case SVI was lower when the slud content was higher. Interpretation of the resu from different sludges pointed that the diameter the settling glass might influence SVI. (Shanka Texas)
W70-08900

INSTRUMENTATION FOR HYDROGEN SUL FIDE MEASUREMENTS,
Los Angeles Bureau of Sanitation, Calif.
William F. Garber, Joe Nagano, and Frank F. Wada.
Journal Water Pollution Control Federation, Pa II, R209-R220, May 1970, Vol 42, No 5. 10 fig, 1 ref.

Descriptors: *Instrumentation, *Hydrogen sulfite *Measurements, *Analysis, Testing, Waste wate treatment, Sewage, Test procedures, Volumetri analysis, Sewage treatment.
Identifiers: *Detection, Inorganic sulfide.

The generation and release of hydrogen sulfide with subsequent odor and corrision problems is factor of concern in almost all waste water systems but particularly in areas where organic strength i high and average waste water temperatures exceed 70 to 72 deg F. Although previous work provided considerable insight into the mechanisms of sulfid generation and release studies of these specific problems require extensive action and continuous testing capabilities. A number of sulfide tes procedures have been developed over the years Each of these has been of value under certain conditions and in fact often satisfying needs for portability, low initial cost and spot testing as well as the more sophisticated continous operation. However, in depth studies ultimately require accurate, automated continuous testing capability. For continuous measurement a lead acetate tape an early coulometric instrument and the present coulometric instrument capable of both liquid and gaseous phase analysis has been examined. The improved automated lead acetate method has had wide applicability where the concentration range was predictable, and specific reaction with hydrogen sulfide was important; however, the current coulometric method appears to be the most accurate. (Hancuff-Texas)
W70-08902

KITCHENER PRE-TREATMENT PLANT REDUCES CITY LOADING BY 20%,
Reid, Crowther and Partners Ltd.
R. R. Parker.
Water and Pollution Control, Vol 108, No 3, p 16-19, March 1970. 1 fig.

Descriptors: *Waste water treatment, Industrial wastes, Flotation, Sedimentation, Screens, Farm wastes.
Identifiers: *Meat packing wastes, Manure, Kitchener (Ontario, Canada).

The J. M. Schneider, Ltd. operates a meat packing plant which kills and processes cattle, hogs, and poultry and produces both fresh and cooked products. Its waste water streams total 1.4 MGD with up to 27,000 lbs BOD, 20,000 lbs suspended solids, and 12,000 lbs ether solubles. The City of Kitchener, Ontario requested this waste load be reduced to 900 ppm BOD, 600 ppm suspended solids, and 200 ppm ether solubles, based on an average of the consecutive 24 hour composite samples. The company installed two sewers, one containing fat bearing waste water (95% of the total flow) and the other containing manure bearing wastes. Sanitary sewage and storm sewage go to city facilities through existing lines. The fat bearing

stream is passed through a vibrating 1/4 inch mesh screen where large particles are removed. The effluent goes into an equalization tank and then into a combination flotation-sedimentation unit. Grease is removed by flotation, solids by sedimentation. Manure bearing wastes are screened on 100 mesh vibrating screens. Effluent from both streams goes to municipal sewers. Screenings are taken to landfill. The grease disposal problem remains unsolved. The units involved in both treatment plants are discussed in detail. The City of Kitchener treatment plant reported a 20% reduction in the loading on its plant after the meat-packing plant installed its own treatment plant facilities. (Makela-Texas)
W70-08903

ALGAL FLOCCULATION WITH ALUMINUM SULPHATE AND POLYELECTROLYTES,
New South Wales Univ., Kensington (Australia).
Michael G. McGarry.
Journal Water Pollution Control Federation, Part II, p R191-R207, May 1970, Vol 42, No 5. 6 fig, 4 tab, 14 ref.

Descriptors: *Algae, *Flocculation, Equipment, Costs, Separation techniques, Coagulation, Waste water treatment.
Identifiers: *Alum, Polyelectrolytes, Factorial design.

The high rate pond process is being developed to treat waste water and to provide a new source of edible protein in the form of algae. As a food production process, the yield of algae exceeds the yields of all currently known grain crops. Recent studies in Thailand have indicated that protein production rates of 25 tons/year/acre are quite easily acheived on a pilot plant scale. This yield compares favorably with that of wheat, 135 lb/year/acre and that of soy beans 576 lb/year/acre. Aluminum sulfate was tested as a primary coagulant in conjunction with a variety of polyelectrolytes for chemical flocculation as a means of harvesting the dispersed algae from heavily laden pond water. The independent variables studied were alum and polyelectrolyte concentrations, time of polyelectrolyte addition, fast and slow mixing period and degree of turbulence. Dependent variables considered were: supernatant transmission and settled volatiles as a measure of harvest of algae, after one hour of settlement. Cost of algal havesting by alum alone at concentrations of 30 mg/l would be prohibitive. The overall minimum cost per unit of algal yield was attained with alum along at dosage range of 75 to 100 mg/l of alum. (Hancuff-Texas)
W70-08904

AUTOMATIC ASSESSMENT OF RESPIRATION DURING GROWTH IN STIRRED FERMENTORS,
Shell Research Ltd., Sittingbourne (England).
Douglas W. Ribbons.
Applied Microbiology, Vol 18, No 3, p 438-443, Sept 1969. 8 fig, 19 ref.

Descriptors: *Respiration, *Fermentation, *Oxygen demand, *Dissolved oxygen suspensions, Environment, Methane, Viability, Growth chambers.
Identifiers: *Stirred fermentors, *Glucose limiting media, *Dissolved oxygen electrode, *Oxygen uptake, Thermotolerent bacterium, Gaseous exchange.

Continuous measurement of respiration during growth of microorganisms is a valuable information in understanding the growth culture. An apparatus for continuously recording respiration is described. All the other methods are briefly explained. A comparison of the present method is made with the other methods and the advantages are brought out. The apparatus is primarily used to investigate gaseous exchange that occurs during bacterial growth. Respiration of Escherichia coli, Pseudomonas aeruginosa, Bacillus Thuringiensis and Methylococcus capsulatus are measured during growth on complex and defined media. Results of the study of P. aeruginosa in ammonium limited media and glucose limited media are compared. Data obtained are not used for establishing any quantitative relationships but to understand the growth process. (Radhakrishnan-Texas)
W70-08905

AERATION ON AN INCLINED TRANSVERSELY CORRIGATED SOLID SURFACE,
Louisiana Polytechnic Inst., Ruston.
H. K. Huckabay, and Arthur G. Keller.
Journal of Water Pollution Control Federation, Part II, p R202-R208, May 1970. 4 fig, 10 ref.

Descriptors: *Aeration, *Mathematical model, Industrial waste, Sewage treatment, Waste water treatment, Corrigated metal, Aerator, Fluid dynamics, Inclination, Metal sheet.

Gravity flow down an inclined transversely corrigated solid surface appears to be a method of aeration deserving of wide-spread consideration. The experimental apparatus used in this study was corrigated galvanized iron with sinusoidal characteristics of 1.25 inches amplitude. The cascade board was varied from an inclination of 5 to 30 deg from the horizontal. The range of water temperature studied was from 28 to 42 deg C. Water flow rate was varied from 0.02 to 0.08 million gallons/day/foot width. By standard statistical techniques it was determined that K sub la, the coefficient of mass transfer, was a function of the angle of inclination and throughput and N sub t, the number of transfer units, was a function of the angle in inclination only. The transfer unit is independent of flow-rate and implys the ability of the cascade to undergo large-scale surges in volumetric input without a change in aeration performance. (Hancuff-Texas)
W70-08906

COMPARISON OF WASTE WATER SAMPLING TECHNIQUES,
Southwest Research Inst., San Antonio, Tex.
D. S. Tarazi, L. L. Hiser, R. E. Childers, and C. A. Boldt.
Journal of Water Pollution Control Federation, Vol 42, No 5, Part I, p 708-732, May 1970. 10 fig, 11 tab, 6 ref.

Descriptors: *Sampling, *Statistics, *Monitoring, Waste water treatment, Automation, Analytical techniques, Statistical method, Probability, Evaluation.
Identifiers: *Sampling techniques, *'T' tests, Grab samples, Waste water characteristics.

A significant difference exists between the data obtained by grab sampling and by flow-weighted composite sampling. The significance of these differences was mainly dependent on the following factors: (1) the overall time period for which the waste water is to characterize, i.e., whether daily or other time increments of pollution loading are to be determined, (2) the confidence levels desired, (3) the variability of both quality and quantity in the specific waste water stream, and (4) whether concentration levels or material transport rates are desired. A comparison is made between grab samples and weighted composites for several industries on the Houston ship channel. From past experience that the number of grab samples required to be equivalent even with 90% confidence limits to a flow-weighted composite is excessive for most of the waste water entering the ship channel. Two waste water streams were utilized in this demonstration. Daily composite and grab samples were taken from both flows. Analyses determined on the first included pH, total residue, filtered COD, TOD, total filtered carbon, and inorganic filtered carbon. The second stream included only total, filterable and non-filterable residues. The 'T' test is used to statistically analyze the collected data and develop confidence limits. (Hancuff-Texas)
W70-08907

SCUM INCINERATION EXPERIENCES,
East Bay Municipal Utility District, Oakland, Calif.
Elmer E. Ross.
Journal of Water Pollution Control Federation, Vol 42, No 5, Part I, p 733-736, May 1970. 1 fig, 3 tab.

Descriptors: *Scum, *Incineration, *Operation and maintenance, *Skimming, Sewage treatment, Waste water treatment, Sediments, Oil, Sludge disposal, Costs, Air pollution, California.
Identifiers: *Experiences, Gas analysis, Non-digestable, Gravity flotation, Oakland (Calif).

The East Bay Water Pollution Control system of Oakland, California is designed to give primary treatment to an average dry weather flow of 128 MGD and handle a maximum of 291 MGD. The treatment process consists of pre-chlorination, screening, grit removal, sedimentation, post-chlorination and sludge digestion. During the early years of operation it was found that the sedimentation tank scum which was then pumped to the digestion system with raw primary sludge contained appreciable amounts of petroleum oil, and other industrial wastes which were not readily digestible. This problem initially lead to the installation of a gravity flotation type thickener in which the raw skimming and digestion scum were concentrated and hauled to off-plant sanitary fills. The high cost of this method of disposal, in excess of $12,000 annually for hauling alone resulted in the installation in 1964 of an incineration plant. The 10.75 ft. 6-hearth unit is designed for 20 ton/day and automatic operation to minimize operator attention. To meet the air pollution control district standards the furnace was equipped with a Venturi-type wet scrubber and cyclonic separator. The heat value of the scum on a dry basis is between 14,000 and 16,000 BTU's/lb. Moisture content varied from 48.6% to 42.5% in 1968. The maximum temperature maintained within the furnace varies from 1500 to 1800 deg F. (Hancuff-Texas)
W70-08908

THE USE OF FLY ASH IN WASTE WATER TREATMENT AND SLUDGE CONDITIONING,
Cincinnati Univ., Ohio.
J. David Eye, and Tapan Kumar Basu.
Journal of Water Pollution Control Federation, Vol 42, No 5, Part II, p R125-R135, May 1970. 4 fig, 9 tab, 8 ref.

Descriptors: *Sludge, *Fly ash, *Waste water treatment, Sludge disposal, Sewage treatment, Filterability, Laboratory tests, Costs, Chemical oxygen demand.
Identifiers: *Sludge conditioning, Settleability, Suspended solids.

Fly ash is capable of reducing COD of a secondary effluent by about 30% at a fly ash concentration of about 1600 mg/l when the initial COD is around 60 mg/l. The removal of suspended solids containing fly ash by coagulation with lime is highly efficient. With an overflow rate of 330 gal/day/sq ft about 98% of the suspended solids were removed. Fly ash is a useful agent in conditioning sludge prior to vacuum filtration. Although fly ash has the great advantage of being very cheap and readily available in most industrial areas an additional initial expenditure is required for suitable mixing and feeding equipment for fly ash use in an existing plant using conventional methods of sludge conditioning. Characteristics of fly ash are presented and its usefulness described. It weighs 30 lb/cu ft, has a carbon content of 1 to 60%, a specific gravity of 2.1 to 2.55 and specific surface area of 2,970 and 6420 sq cm/gm. (Hancuff-Texas)
W70-08909

CLARIFICATION-ADSORPTION IN THE TREATMENT OF MUNICIPAL AND INDUSTRIAL WASTE WATER,
Calgon Corp., Pittsburgh, Pa.
D. G. Hager, and P. B. Reilly.
Journal of Water Pollution Control Administration, Vol 42, No 5, p 794-800, May 1970. 9 tab, 4 ref.

Descriptors: *Adsorption, *Waste water treatment, *Sewage treatment, *Activated carbon, *Costs, Industrial wastes, Performance, Biochemical oxygen demand, Reliability.
Identifiers: Requirements, Total organic carbon.

Over the last three years many laboratory and field evaluations have confirmed the technical and economic feasibility of treating raw municipal waste water with granular activated carbon after preliminary flocculation and settling to reduce suspended solids. Adsorption isotherm studies were conducted on raw waste water from 11 municipal plants located principally in Western Pennsylvania. The results of these tests are tabulated in terms of total organic carbon. The pounds of carbon required to treat waste water are shown as pounds per million gallons and indicate a wide range between 542 and 4280 for 90% TOC removal and between 572 and 5050 for 95% TOC removal. It is stated that the break even point when comparing economics of activated sludge and activated carbon is a carbon dosage of 300 to 1000 pounds per million gallons. A cost comparison is given between the activated sludge system for 10 MGD plant at 90% BOD removal and the clarification-adsorption process for 95% removal. The activated sludge plant construction cost is estimated at 3.883 million dollars as compared to 3.359 million dollars for adsorption-clarification plant. A summary of the operating costs of the two systems is tabulated. A total of $0.091/1000 gallons is presented for the activated sludge system and $0.107/1000 gallons for the clarification-adsorption system. Combining operating costs with amortization of capital the two systems are essentially identical amounting to $0.178/1000 gallons for activated sludge and $0.179/1000 gallons for clarification-adsorption. (Hancuff-Texas)
W70-08910

THE MANNING EQUATION AND BOUNDARY RESISTANCE,
Guelph Univ. (Ontario).
Peter S. Chisholm, and G. Tsang.
Journal of Water Pollution Control Federation, Vol 42, No 5, Part 1, p 753-757, May 1970. 2 fig, 7 ref.

Descriptors: *Sewers, *Manning's equation, *Variability, Evaluation, Pipes, Flow, Flow rates, Friction, Hydraulic gradient, Design, Reynolds number.

Contrary to Manning's (Trans. Inst. Civil Eng Ireland: 2021, 1889) original conclusions n is not a function of boundary roughness alone. Within the design range selected for illustration n increases with increasing conduit size and effective roughness and decreases with the Reynolds number. The selection of correct effective roughness value for design is important to correct assessment of boundary resistance to flow. Available data illustrate that effective roughness of concrete-walled conduit is between 1 and 2 orders of magnitude less than values often attributed to that material. For example, the roughness value recommended for concrete ranges between 0.001 and 0.01 feet. Available experimental data indicate that the range for pre-cast sewer pipe with average field joints is between 0.00015 to 0.00023 feet. Resistance to flow due to factors other than wall roughness must be accounted for in design; thus the values of n often are modified to account for both predictable and anticipated field conditions. (Hancuff-Texas)
W70-08911

OPERATOR DEVELOPMENT--PACIFIC NORTHWEST,
Washington State Water Pollution Control Commission, Olympia.
Russell K. Taylor.
Journal of Water Pollution Control Federation, Vol 42, No 5, Part I, p 704-707, May 1970.

Descriptors: *Training, *Education, Operation and maintenance, Sewage treatment, Waste water treatment, Personnel, Permits.
Identifiers: *Operators, *Certification, Incentives, Personnel development.

The Pacific Northwest has seen many changes and developments in the municipalities responsibility for maintaining water quality standards. The effects of these changes on water pollution control plant operators is evaluated and the outlook for the operator of tomorrow is assessed. Comments are made with reference to Washington State, but these comments reflect the activities in each state of the Pacific Northwest. In its solutions to the many problems associated with water pollution, Washington State Water Pollution Control Commission has adopted a regulation and a plan of implementation for interstate, intrastate, and coastal waters for the protection and maintenance of water quality in the State of Washington. In order to accomplish these goals, there is a need for training 490 pollution control plant operators by 1974. The training needs of the State of Washington exist in four areas: (1) Preparatory training, (2) Skill maintenance, (3) Skill improvement, (4) Emergency training. The operators of the State of Washington have participated in a voluntary certification program for several years and to date there have been 516 certificates of competency issued by the State Certification Board. Of these there are more than 400 active certificates held in industry. The Washington State Department of Health has drafted a mandatory certification bill for water works and for water pollution control plant operators which is anticipated to be considered by the 1971 legislature. (Hancuff-Texas)
W70-08912

AN EVALUATION OF THE STANDARD BIOCHEMICAL AND ELEVATED TEMPERATURE TESTS FOR DIFFERENTIATING FAECAL AND NON-FAECAL COLIFORMS,
Central Public Health Engineering Research Inst., Nagpur (India).
R. P. Mishra, S. R. Joshi, and P. V. R. C. Panicker.
Water Research, Vol 2, p 575-585, 1968. 4 tab, 29 ref.

Descriptors: *Coliforms, *Evaluation, *Laboratory tests, Sewage bacteria.
Identifiers: *Biochemistry, Differentiation.

The relative efficacies of the biochemical IMViC and the elevated temperature (FC) tests have been compared for differentiating the faecal and non-faecal coliforms. Altogether 1628 coliform strains comprised of 427 from 143 samples of human faeces, 301 from 101 samples of cattle faeces, 631 from 113 samples of sewage and 269 from 120 samples of soil were classified as to their IMViC types and response to elevated temperature reactions. Parr's Escherichia group (++--, +--- and -+--) was represented by 83 and 85% of the coliform strains isolated from human and cattle faeces respectively. Of the coliform strains isolated from human cattle faeces 82.0 and 76.4% respectively were found positive for the FC test. Neither the IMViC nor the FC tests by themselves can be considered adequate for differentiating coliforms of faecal and non-faecal origin. (Aguirre-Texas)
W70-08913

MANPOWER CRISES LEADS TO PROGRAMS FOR TRAINING POLLUTION-ABATEMENT TECHNOLOGISTS,
Charles County Community Coll., La Plata, Md.
Carl M. Schwing.
Water and Wastes Engineering, Vol 1, No 3, Mar 1969, p 56-58.

Descriptors: *Education, *Personnel management, Pollution abatement, Training, Waste water treatment, Maryland.
Identifiers: La Plata (Md).

Personnel at Charles County Community College, La Plata, Maryland, have developed a program to provide training for individuals in pollution abatement technology. The FWPCA has estimated a need for 18,500 trained waste water treatment plant operators over the next five years, with an additional 23,000 trained technicians. The college program includes: (1) an annual training course for treatment plant operators already in the field, (2) professional seminars for operators, (3) a two-year Associate of Arts degree in pollution abatement technology leading to employment in supervisory or technicial positions in operating or regulatory agencies or in industry. The facilities at the college include a $1.2 million science and technology center housing classrooms and laboratories and a computer. The college will have its own waste water treatment plant treating waste water from the college and surrounding community. This plant will be used in the training courses. (Makela-Texas)
W70-08914

PHOSPHORUS REMOVAL FROM EFFLUENTS IN ALUMINA COLUMNS,
Battelle-Northwest, Richland, Wash.; and Robert A. Taft Water Research Center, Cincinnati, Ohio.
Lloyd L. Ames, Jr., and Robert B. Dean.
Journal, Water Pollution Control Federation, Vol 42, No 5, Part II, p R161-R172, May 1970. 6 fig, 4 tab, 20 ref.

Descriptors: *Phosphorus, *Columns, *Costs, *Tertiary treatment, Effluents, Efficiencies, Adsorption, Waste water treatment, Sewage treatment.
Identifiers: *Alumina, Loading, Regeneration, Elution.

An alumina column treating a synthetic secondary waste water effluent was studied. Small 1.1-cm-diameter by 8-cm-high columns were used for the study. The alumina adsorption phenomena has been considered to be essentially a highly selective ion exchange process with phosphorus also involved in a secondary adsorption reaction. At 10% breakthrough the throughputs for 10.3, 7.0 and 3.5 mg P/l in the standard influent were 900, 1400 and 1900 column volumes respectively. The competition or effects of other anions on phosphorus removal was of interest because large concentrations of other anions could significantly lower the phosphorus capacity of the alumina. The sulphate ion was chosen to demonstrate the interfering effects on phosphorus capacity. The concentration of magnesium and calcium also showed marked effects on alumina column phosphorus capacity. Adsorption on the alumina occurs partly as a calcium or magnesium phosphorus complex rather than a simple phosphorus anion. Elution of phosphorus was accomplished with 8 column volumes of 1 molar sodium hydroxide followed by 20 columns of wash water. Estimated treatment cost including filtration for a 10 MGD plant is between 5 and 6 cents/1000 gallons for secondary effluent containing 10 to 12 mg P/l. (Hancuff-Texas)
W70-08915

TECHNIQUES FOR ESTIMATING CONSTRUCTION COSTS OF WASTE TREATMENT PLANTS,
Oklahoma Univ., Norman.
Kanti L. Shah, and George W. Reid.
Journal of Water Pollution Control Federation, Vol 42, No 5, Part I, p 776-793, May 1970. 1 fig, 9 tab, 18 ref.

Descriptors: *Construction, *Costs, *Waste water treatment, *Sewage treatment, *Statistics, *Mathematical models, *Regression analysis, Industrial waste, Sampling, Design, Stabilization, Ponds, Trickling filter, Activated sludge.
Identifiers: Variables, Primary treatment.

Regression equations based on statistical techniques have been developed for estimating the unit construction costs of municipal waste treatment plants, both in terms of design flow and population equivalency. Regional differences were taken into account in analyzing the data and all reasonable combinations of variables which were thought to affect cost were considered. Two

methods have been used to develop equations; (1) by analyzing separately the data of each type of plant, and (2) by combining the data and using dummy variables for the type of treatment plant. 809 letters with questionnaire forms were mailed including 49 letters to state health directors; 563 were completed. Data on 102 primary treatment plants were obtained. The relationships between the variables: cost per million gallons and flow in mgd were derived. For stabilization ponds only 12 of 157 plants reported current performance of treatment. Sample size for the standard rate trickling filter was 67 and an equation is derived for estimating unit construction cost in terms of dollars per mgd. Data on 120 high-rate trickling filter plants were obtained. Activated sludge treatment plants had a sample size of 115. The data on standard rate trickling filter, high-rate trickling filter, and activated sludge plants were combined and regression analysis was made with a sample size of 304. Since the logarithmic transformation of the variables gave the best fit, dummy variables were used in this form of linear equation. (Hancuff-Texas)
W70-08916

IMPROVED SETTLING TANK EFFICIENCY BY UPWARD FLOW CLARIFICATION,
British Wedge Wire Co. Ltd., Warrington (England).
V. R. Sparham.
Journal of Water Pollution Control Federation, Vol 42, No 5, p 801-811, May 1970. 3 fig, 2 tab, 10 ref.

Descriptors: *Settling basin, *Efficiencies, *Performance, *Sewage treatment, Beds, Trickling filter, Waste water treatment, Effluent.
Identifiers: *Upflow clarifier, Suspended solids.

Settleability of suspended solids from biological treatment of waste water varies widely. Polishing processes should not be relied on to substitute for poor settlement tank performance, which should be improved to insure an acceptable effluent for polishing process. For best results settlement tanks fitted with upflow clarifier elements should have a high surface volume ratio. Use of upflow pebble bed clarifiers in many smaller existing horizontal flows final settlement tanks improves settled effluent quality by 50% at maximum flows of 1 cu m/sq m/hr. The use of a single layer of wire mesh nearly eliminates pebble bed backwashing operations and costs while improving settlement tank performance by 50% at fully treated flow rates of up to 1 cu m/sq m/hr. Wedge wire mesh used in conjunction with suitable plastic matrices can reduce the suspended solids in settled effluent by 90% at 1 cu m/sq m/hr fully treated flow, and by 70% at 3 cu/m/sq m/hr for limited periods. A typical bed is described as 6 inches of gravel of 0.250-0.375 inches in diameter suspended 12 inches below the top water level of a final sediment tank. These clarifying elements may be adopted for stabilizing hydroxide floc blankets or activated sludge blankets in conventional potable water and waste water treatment. (Hancuff-Texas)
W70-08917

SIMPLIFIED GRAPHICAL EVALUATION OF BOD CURVE CONSTANTS,
Jadavpur Univ., Calcutta (India).
Dipak Bagchi, and Nilay Chaudhuri.
Journal of Water Pollution Control Federation, Vol 42, No 5, Part II, p R136-R139, May 1970. 6 fig, 3 tab, 2 ref.

Descriptors: *Mathematical model, *Computers, *Computer program, Laboratory tests, Analyses, Evaluation, *Biochemical oxygen demand.
Identifiers: *Graphical methods.

The method suggested by Fujimoto (Journal Water Pollution Control Federation, Vol 36:69, 1964) for the evaluation of first stage BOD curve constants is further simplified. The reorganized BOD equation shows a linear relationship between y sub t (BOD exerted in time 't') and y sub t+h-y sub t where y sub t+h is the BOD exerted in time t+h and can be used to evaluate the parameters L sub o the ultimate first-stage BOD and k the rate constant. The value of L is obtained directly from the graph as the intercept of the line on the absicca. The graphical technique can be used for evaluation even when BOD data are collected at irregular intervals of time. Evaluation of L sub o and k utilizing a digital computer becomes handy when a great bulk of data is to be processed. (Hancuff-Texas)
W70-08918

EVALUATION OF A COMPLETE MIXING ACTIVATED SLUDGE PLANT,
Kansas Univ., Lawrence.
Ross E. McKinney, Henry H. Benjes, Jr., and James R. Wright.
Journal of Water Pollution Control Federation, Vol 42, No 5, Part I, p 737-752, May 1970. 10 fig, 1 tab, 19 ref.

Descriptors: *Activated sludge, *Data collections, *Performance, *Mathematical model, Design, Facilities, Operation, Biochemical oxygen demand, Biological treatment, Evaluation, Waste water treatment, Nebraska.
Identifiers: *Complete mixing, Suspended solids, Grand Island (Nebraska).

Although complete mixing activated sludge waste water treatment plants have been in operation for a number of years there has been a reluctance to use this modification, mainly because of a lack of understanding of the fundamental concepts of biological waste water treatment, and in part due to the lack of sufficient operational data to give engineers confidence in the results which could be expected. Results of a 2.5 year study to obtain operational data from the Grand Island Waste Water Treatment plant in Nebraska is presented. In 1969 the water water flow of 5 MGD was 86% of the expected 1995 flows and the BOD was 78%. The aeration tank has a 3.8 hour detention time, BOD5 loading of 116 lb/cu ft/day about 4000-5000 mg/l mixed liquor suspended solids and 560 cu ft of air/lb of BOD5 load. The final effluent had an average of 7 mg/l BOD5, 98% reduction, in 1969 with an average of 3 mg/l BOD5, 99% reduction, for a 2.5 month period in April, May and June of 1969. The aeration system operated satisfactorily with air flow rates as low as 400 cu ft/lb BOD5 with an oxygen transfer of 0.47 lb O2/lb BOD5. The low oxygen transfer rate resulted in greater production in activated sludge than in conventional activated sludge systems. Excessively long storage in primary and secondary sedimentation tanks created definite operation problems with the transfer of much of the organic load from the primary system to the aeration system. (Hancuff-Texas)
W70-08919

MODEL OF NATURAL DRAFT COOLING TOWER PERFORMANCE,
Federal Water Quality Administration, Corvallis, Oreg. Pacific Northwest Water Lab
Lawrence D. Winiarski, and Bruce A. Tichenor.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 96, No SA4, Paper 7461, p 927-943, August 1970. 11 fig, 2 tab, 7 ref, append.

Descriptors: *Cooling towers, *Thermal powerplants, *Mathematical models, *Computer programs, Evaporation, Heat transfer, Mass transfer, Water temperature, Thermal pollution, Water pollution control.
Identifiers: Natural draft cooling towers.

A method is developed for analyzing the performance of counterflow and crossflow natural draft cooling towers that does not assume saturated air at the top of the packing. Types of cooling towers and the principles of operation are considered. Simplified differential equations for the heat and mass transfer relations and the methods of integrating them for both counterflow and crossflow towers are given. A large number of integration steps is shown to be unnecessary. Equations for estimating the pressure losses in the tower are also given. Simplified flow charts using these integration schemes show how the computer program is used to evaluate tower performance. The computed performance of towers of various heights operating in moist and in dry conditions is shown. The effect of inlet water temperature is shown to be significant. Finally, the computed performance of a given tower with fixed inlet water temperature is shown as a function of relative humidity and dry bulb air temperature. (Knapp-USGS)
W70-08945

BULKING OF DAIRY WASTE ACTIVATED SLUDGE,
Agricultural Univ., Wageningen (Netherlands).
A. D. Adamse.
Water Research, Vol 2, p 715-722, 1968. 3 fig, 3 tab, 12 ref.

Descriptors: *Activated sludge, *Bacteria, *Dairy industry, Industrial wastes, Nutrient requirements, Oxygen requirements.
Identifiers: *Arthrobacter, *Bulking, *Sphaerotilus, Carbon-nitrogen ratio, Oxygen tension.

The phenomenon of bulking of a dairy waste activated sludge was studied in relation to known and estimated data concerning two types of microorganisms involved in the mechanism of bulking, vig. Sphaerotilus and Arthrobacter-like bacteria. Reduced oxygen supply, resulting from the high dissimilation rate of the carbohydrate fraction of the dairy waste, together with the ability to accumulate storage compounds and the discrepancy between the potential and actual C/N ratios of this waste, were considered to be the mainfactors in stimulating growth of Sphaerotilus, and thus to be responsible for bulking. Alteration of the nutritional conditions caused an improvement of the growth of Arthrobacter-like bacteria and this led to a pronounced relative suppression of Sphaerotilus, as a result of which the settling properties of the sludge were restored. (Aguirre-Texas)
W70-08954

ALL PARTIES CAN BENEFIT FROM JOINT MUNICIPAL-INDUSTRY TREATMENT,
Procter and Gamble Co., Cincinnati, Ohio. Corporate Environmental Control.
J. Floyd Byrd.
Water and Sewage Works, Vol 116, No 11, p IW14-IW21, November 1969. 2 fig.

Descriptors: *Wastes, *Water quality, *Economics, Biochemical oxygen demand, Efficiency Pollution abatement.
Identifiers: *Joint municipal-industry treatment, *Ordinance, Sewer tax, Flammable waste.

The technical aspects of joint treatment of wastes from many industries, commercial enterprises and house holds are discussed. In addition to the savings by a joint treatment operation, there are also many advantages: (1) Waste treatment is merely a sideline to industry's main effort of manufacturing and marketing a product, whereas combined treatment does the job effectively as they are done by the specialists. (2) Land availability is an important factor favoring combined treatment. (3) Domestic sewage contributes nutrients and dilution to industrial wastes, making them more amenable to degradation. The paper then refers to the suggested municipal sewer ordinance outlined in the Water Pollution Control Federation Manual of Practice No 3 entitled 'Regulation of Sewer Use.' The objectives of the municipal sewer ordinance are described and the requirements to achieve those objectives are discussed. The paper recommends that the chief engineer of the sewage treatment plant should be given enough discretionary powers to take care of unusual wastes. Certain wastes should not be banned automatically, just limit their quantities so as not to affect biological treatment adversely. The spirit of cooperation and mutual trust between municipality and industry must exist. (Shankar-Texas)
W70-08955

BACTERIA AND LAGOONS,
Department of Interior, Atlanta, Ga.
J. R. Franzmathis.
Water and Sewage Works, Vol 117, No 3, p 90-92, March 1970. 3 fig, 2 tab, 13 ref.

Descriptors: *Waste water treatment, *Stabilization, *Ponds, *Bacteria, *Coliforms, *Performance, *Lagoons, Effluents, Summer, Winter, Southeast U.S.
Identifiers: Fecal, Loading rates.

Waste stabilization ponds in the Southeast were sampled for effluent bacterial densities. It was found that single-cell ponds effluents did not meet the criterion set forth in the Report of The Committee on Water Quality Criteria which recommended an average not to exceed 2,000 fecal coliform per 100 ml. Three ponds of 2, 2.6 and 6 acreas, loaded at an estimated 16, 18 and 41 lb/acre/day, respectively were sampled and 593 analyses were performed during January and February 1968. The pond loaded at 41 lb/acre/day was sampled again in July and August 1968, and 184 analyses were performed. Average effluent fecal coliform density during the winter for all ponds was reported to be 56,000/100 ml. Results for the pond loaded at 41 lb/acre/day were 87,000 and 1,366,000/100 ml for winter and summer respectively. Limited sampling on larger ponds found an average fecal coliform density of 71,000/100 ml from an 8 acre pond loaded at an estimated 31 lb/acre/day, and 278,000/100 ml from two 36 acre ponds loaded at an estimated 26 lb/acre/day. It was recommended that controlled retention rather than uncontrolled average detention time must be the goal of design, if disinfection is not utilized. (Galwardi-Texas)
W70-08957

THE BIOLOGICAL TREATMENT OF CARBONIZATION EFFLUENTS--II. STUDIES OF THE INFLUENCE OF LIQUOR COMPOSITION,
British Coke Research Association, Chesterfield (England).
A. G. Ashmore, J. R. Catchpole, and R. L. Cooper.
Water Research, Vol 2, p 555-562, 1968. 4 fig, 3 tab, 1 ref.

Descriptors: *Biological treatment, *Industrial wastes, Activated sludge, Aeration, Investigations, Carbon, Coals.
Identifiers: *Carbonization effluents, *Liquor composition.

Studies of the influence of composition on the treatability of carbonization liquors have been made by determining their minimum period of aeration, in single-stage completely-mixed activated sludge systems. Using solutions of ammonium thiocyanate as the basic substrate, precise information has been obtained of the complex relationship between influent strength and rate of treatment. For ammonium thiocyanate alone, a stepwise relationship was observed between concentration and minimum period of aeration. The effect of the addition of 1000 mg/l of phenol was to modify this relationship to give a constant minimum of 30 hours for the range 300-1000 mg/l of CNS, reducing rapidly at lower CNS concentrations, thus illustrating the complex effect of dilution as found in liquor treatment. The inhibition due to the intractable permanganate value residue, present in biologically treated effluents, was conveniently simulated by addition of small amounts of oxidized catechol to the influent. The effect of these additions has been studied with synthetic solutions and with limed spent liquor, over a wide range of concentrations, and could be determined with a high degree of reproducibility. The results illustrate the profound influence of this type of inhibitor upon the economics of liquor treatment. (Aguirre-Texas)
W70-08958

A BIOLOGICAL AND CHEMICAL STUDY OF SEVERAL ANEROBIC DIGESTERS,
National Inst. for Water Research, Pretoria (South Africa).
J. P. Kotze, P. G. Thiel, D. F. Toerien, W. H. J. Hattingh, and M. L. Siebert.
Water Research, Vol 2, No 3, p 195-213, March 1968. 1 fig, 12 tab, 21 ref.

Descriptors: *Anaerobic digestion, *Biological properties, *Biological treatment, *Chemical properties, Analysis, Carbohydrate, Chemical analysis, Enzymes, Sewage treatment.

Biological and chemical analyses were carried out on several digesters operated on laboratory, pilot and full-scale. These digesters received a variety of substrates which included raw sewage sludge; industrial effluents, and a synthetic substrate. Hexose monophosphate sluent enzymes could only be demonstrated in very active digesters receiving substrates high in carbohydrate material. The glycolytic pathway, glyoxylic acid and citric acid cycles were found in all the anaerobic digesters analyzed. Enzyme activity tests revealed different stages of adaptation of a raw sewage digester adapted to a synthetic substrate. Digesters receiving different substrates showed characteristic enzyme activity patterns, but chemical analysis such as pH, alkalinity and volatile fatty acid content did not demonstrate any obvious differences between these digesters. (Aguirre-Texas)
W70-08959

WATER CONSERVATION AND REUSE BY INDUSTRY,
Texas A and M Univ., College Station. Environmental Engineering Div.
Robert L. Irvine, Jr., and William B. Davis.
Water and Wastes Engineering, Vol 7, No 1, p 17-19, January 1970. 3 fig, 4 ref.

Descriptors: *Water reuse, *Industries, *Conservation, *Cost analysis, Industrial wastes, Biological treatment, Management, Cost comparisons, Waste water treatment.
Identifiers: *Segregation of wastes.

The concept of water conservation and reuse was presented in order to promote industrial implementation of inplant water management programs. Industry has avoided such programs; assuming that the quantity and quality of its water supply have been and will be constant in time and space. Waste treatment and its associated cost seems to be generally feared. Cost analyses were presented that point out the economic benefits of conservation and reuse. In addition, procedures were described that increase the efficiency of biological waste treatment facilities. The segregation of waste streams was stressed. Also, with the implementation of conservation and reuse programs, the cost of waste treatment becomes part of the production scheme. (Galwardi-Texas)
W70-08960

CASUAL OBSERVATIONS OF PROTOZOA IN TERTIARY SEWAGE TREATMENT,
Illinois State Water Survey, Peoria, Ill.
Ralph L. Evans, and Davis B. Beuscher.
Water and Sewage Works, Vol 117, No 2, p 35-41, February 1970. 6 fig, 2 tab, 18 ref.

Descriptors: *Activated sludge, *Biological communities, *Biota, *Efficiencies, *Ecology, *Protozoa, *Tertiary treatment, Biochemical oxygen demand, Dissolved oxygen, Regression analysis, Retention, Sewage lagoons, Turbulence, Waste water treatment.
Identifiers: *Biological examinations, Biological activity, Suspended solids.

Observations were made of predominant fauna (protozoa) in a tertiary sewage treatment (TSP) complex interposed between the treated effluent of an activated sludge plant and the receiving stream, the Illinois River. The tertiary unit was preceded by an activated sludge process. A brief review of the ecology of activated sludge is presented. Results of the test showed that the average reductions based on about 260 samples, were 23% and 41% for BOD5 and suspended solids respectively. The regression equations developed, defining the probable relationships of suspended solids to BOD5 suggest that BOD5 reduction is not solely a function of the sedimentation of suspended solids. Biological activity did not appear to be beneficial. Predominant protozoa observed in the pond system were flagellates, while cilates were dominant in the aeration units. The average concentration of protozoa was greater than 2000000 organisms per liter with ciliates either absent or in concentrations less than 500000 organisms per liter. Because of the apparent advantage of the ciliated protozoa and the non-beneficial nature of the flagellates it may seem desirable to create condtions within a TSP to stimulate their productivity. Also a slight increase in DO might be beneficial. (Shankar-Texas)
W70-08961

WASTE WATER FOR GOLF COURSE IRRIGATION,
California State Water Resources Control Board, Goleta.
David L. Sullivan.
Water and Sewage Works, Vol 117, No 5, p 153-159, May 1970. 7 fig, 1 tab.

Descriptors: *Effluents, *Soil properties, *Irrigation, *Grasses, Biological properties, Bioindicators, Chlorination, Oil, Alkalinity, Disinfection, Sludge digestion, Reuse.

The use was demonstrated of sewage treatment plant effluent for grass irrigation in a new city golf course. A project was designed to point out the advantages and disadvantages of effluent irrigation, to select a suitable grass, and to determine the feasibility of this course of action. A 4-acre plot in Ventura was chosen to conduct the study. The grasses chosen for the study were old orchard, sea side bent, and Kentucky blue grass. Secondary clarifier effluent from the East Side Plant was used rather than final effluent, so that any bacteriological effects could be studied at a higher level of concentration. About 5 million gallons of digested sludge were spread throughout the area in which the test plots were located. Three plots were chosen for irrigation with domestic drinking water and three for irrigation with treated effluent. At the end of the experiment no harmful effects of effluent irrigation could be noticed in the grace. Oils and grease in the effluent soil had no effect upon growth, since the detergents present dissolved the oils and fats. The tendency of alkalinity, chloride ion concentration and other items to change was of major concern to the study. Kentucky blue grass is not suitable for golf courses since it is very sensitive to salt concentrations. (Shankar-Texas)
W70-08962

PRACTICAL METHODS FOR DETERMINING SEWAGE FLOW FOR ALL COMMUNITIES,
Metropolitan Corp. of Greater Winnipeg (Manitoba).
R. M. Girling.
Water and Sewage Works, Vol 116, No 7, p 250-258, July 1969. 7 fig, 4 tab, 7 ref.

Descriptors: *Instrumentation, *Industrial wastes, *Sampling, Design criteria, Corrosion, Manholes.
Identifiers: *Stilling well, *Radioactive isotopes, *Average flow, *Parshal flume, *Municipal sewage syste, Regulators, Plumb bob.

Measurement of sewage flow rate has become an important aspect in practical sanitary engineering. Starting from the basic concepts of flow measuring devices, the reasons for the measurement of sewage flow rate are enumerated. Various methods of measurement and the corresponding measuring devices are briefly explained, with particular reference to sewage measurement. The circumstances under which a particular type of measuring device is used are explained. The limitations, possible errors while using and the advantages of each type of measuring device are briefly presented. A method for measuring flow rate at sewage pumping stations is also given. Problems are worked out to illustrate the ap-

plication of various devices. (Radhakrishnan-Texas)
W70-08963

PHOSPHORUS REMOVAL--PAST, PRESENT, AND FUTURE,
Maine Univ., Orono; and Illinois Univ., Urbana.
Millard W. Hall, and Richard S. Engelbrecht.
Water and Waste Engineering, Vol 6, No 8, p 50-53, August 1969.

Descriptors: *Nutrients, *Phosphorus, Activated sludge, Chemical precipitation, Coagulation, Ion exchange. Land use, Waste water treatment.
Identifiers: *Phosphorus removal, Chemical-biological processes, Chemical sorption, Electrochemical method.

An economical, predictable and highly efficient process for removing phosphorus from waste waters has not yet been developed. Because of the varied nature of the problem, it is unlikely that a single removal method can be developed for application to all cases. For this reasons, research and development should continue on a variety of processes for phosphorus removal. Methods now being used and developed are: (a) chemical precipitation and coagulation, (b) chemical-biological processes, (c) chemical sorption, (d) electrochemical method, (e) ion exchange, (f) land application, and (h) activated sludge. The addition of lime to secondary effluent, followed by mixing, flocculation and settling can reduce the phosphorus concentration by 99% or more. Sludge disposal is the main problem. The most economical design for a chemical-biological phosphorus removal process should employ chemical treatment prior to biological treatment. The process is considered capable of removing 90 to 95% of total phosphorus from domestic sewage containing 13 to 17 mg/l P and estimated chemical costs of $8 per MG. A comparison of alternate phosphorus removal methods shows that these can range from electrochemical treatment giving 81 to 85% removal for $4 to 8 per MG to algal ponds giving 80 to 90% removal at a cost of $1100 to 1300 per MG. (Aguirre-Texas)
W70-08964

REGENERATION OF OXIDATIVE ASSIMILATION CAPACITY BY INTRACELLULAR CONVERSION OF STORAGE PRODUCTS TO PROTEIN,
Oklahoma State Univ., Stillwater.
K. C. Goll, and A. F. Gaudy, Jr.
Applied Microbiology, Vol 16, No 9, p 1352-1357, September 1968. 4 fig, 7 ref. FWPCA Grant WP 00325.

Descriptors: *Activated sludge, *Microbiology, *Oxidation, *Proteins, Biochemistry, Carbohydrates, Enzymes, Nitrogen, Sludge, Waste water treatment.
Identifiers: *Intracellular conversion, *Storage products, Endogenous respiration, Oxidative assimilation capacity, Substrates.

Previous studies have shown that the capacity of a heterogeneous microbial population for oxidative assimilation of glucose can be renewed by periodically subjecting the sludge to endogenous respiration in the presence of an exogenous source of nitrogen. Further study of this system led to a modification of the activated sludge process for nitrogen-deficient wastes. It was not known whether renewal of oxidative assimilation capacity was possible for substrates which required the presence of inducible enzymes or for substrates which were not carbohydrates. Studies with lactose and acetate as carbon sources were designed. Both carbon sources were removed under conditions of oxidative assimilation, and the storage products were converted into protein when the sludge was subjected to a period of endogenous respiration in the presence of an exogenous supply of ammonium sulfate. The 'regenerated' sludge exhibited a renewed capacity for oxidative assimilation, indicating that requisite inducible enzymes were not diluted out in the endogenous phase to a degree sufficient to hamper renewed oxidative assimilation capacity. A noncarbohydrate carbon source can be successfully removed from the medium with this process. In the case of acetate, the oxidative assimilation capacity after 'regeneration' was not fully restored to the initial level. (Aguirre-Texas)
W70-08965

GROWTH OF MIXED CULTURES ON MIXED SUBSTRATES I. CONTINUOUS CULTURE,
Massachusetts Inst. of Tech., Cambridge.
S. K. Chian, and R. I. Mateles.
Applied Microbiology, Vol 16, No 9, p 1337-1342, September 1968. 6 fig, 1 tab, 16 ref. WASA Grant NsG-496.

Descriptors: *Cultures, *Growth rates, Biochemistry, Coliforms, Microbiology, Pseudomonas, Waste water treatment.
Identifiers: *Mixed cultures, *Mixed substrates.

Continuous culture on mixed glucose-lactose or glucose-butyrate media inoculated with river water led to a population composed of a pseudomonad and a coliform. The glucose was used preferentially to the other carbon source, and the utilization of the secondary carbon source was greatly reduced at high growth rates. Significant amounts of acetate were excreted even though the cultures were limited by the carbon source, rather than by oxygen or other nutrients. At high growth rates, the pseudomonad dominated the population, whereas at low and moderate growth rates the coliform was dominant. A syntrophic relationship was shown by the fact that the pseudomonad could not grow alone on the glucose-butyrate medium. (Aguirre-Texas)
W70-08966

WASTE WATER LOAD EVALUATED AT A MULTI-PRODUCT ORGANIC CHEMICAL PLANT,
Atlas Chemical Industries, Inc., Wilmington, Del.
A. J. Morrissey, and S. A. LaRocca.
Water and Sewage Works, Vol 117, No 5, p 173-178, May 1970. 10 fig, 2 tab, 1 ref.

Descriptors: *Evaluation, *Industrial wastes, *Organic compounds, *Organic loading, *Waste water treatment, Activated sludge, Organic wastes.
Identifiers: *Multi-products.

Atlas embarked on a program to characterize the waste waters discharged from its Atlas Point plant. The program involved sampling all waste waters that the plant generated. Data on oxygen utilization with time for each of these waste water outfalls were obtained. The effect of these discharges on the receiving waters of the Delaware River was investigated. Production data were screened to determine if a relation between process losses and VOD1 discharged could be established. The production equipment within the plant was sampled to provide a basis for segragating cooling waters from other waste waters. Combining all of the waste water outfalls sampled during the outfall sampling program results in a total average flow of about 13,000 gpm. The analyses performed on ten of the plant's waste water outfalls concluded with deoxygenation constants (to the base e) ranging from 0.18 to 0.36. Ratios of VOD1 to BOD5 ranged from 1.19 to 1.67 and averaged 1.45. For the various station averages, pH varied from a low of 6.2 to a high of 8.8; COD from 100 to 14,500 mg/l, BOD5 from 50 to 9000 mg/l and VOD1 from 65 to 12,900 mg/l. Flows averaged in the range from 10 to 9900 gpm. (Aguirre-Texas)
W70-08967

THE EFFECT OF PSYCHODA ALTERNATA (SAY.), (DIPTERA) AND LUMBRICILLUS RIVALIS (LEVINSEN) (ENCHYTRAEIDAE) ON THE EFFICIENCY OF SEWAGE TREATMENT IN PERCOLATING FILTERS,
Water Pollution Research Lab., Stevenage (England).
N. V. Williams, and H. M. Taylor.
Water Research, Vol 2, No 2, p 139-150, February 1968. 19 fig, 3 tab, 18 ref.

Descriptors: *Effects, *Efficiencies, *Sewage treatment, *Trickling filters, Worms, Waste water treatment.
Identifiers: *Psychoda alternata, *Lumbricillus rivalis.

It is said that the macrofauna in trickling filters influence the efficiency of treatment by controlling the growth of film, thus reducing the tendency toward blocking. The present study was designed to establish the effect of the two types of macroinvertebrates, psychodid flies and enchytraeid worms, separately and in mixed populations, on the efficiency of trickling filters. Four groups of triplicate perspex filters were supplied with artificial sewage at a constant temperature of 15 deg C, one group being inoculated with psychodid larvae, one with enchytraeid worms, one with mixtures of flies and worms, and one being kept free as a control. The film in the control group grew rapidly and blocked the filter, causing ponding and producing anaerobic conditions. The efficiency of treatment, measured in terms of BOD and organic carbon removal, decreased from 90% to 40%, some of the carbon being removed by anaerobic decomposition. The two groups containing fly populations showed increased efficiencies (>90%) within 2 months of inoculation, with the larvae successfully controlling the film accumulations. The filter group containing worms achieved similar high treatment efficiencies, but not until 5 months after inoculation, the worm populations increasing more slowly because of longer development periods. (Aguirre-Texas)
W70-08968

FEDERAL GRANTS AVAILABLE FOR INDUSTRIAL POLLUTION CONTROL,
Federal Water Pollution Control Administration, Washington, D.C.
William J. Lacy, and Allen Cywin.
Water and Sewage Works, Vol 116, No 5, p 12-15, May 1969. 1 fig, 1 tab, 3 ref.

Descriptors: *Industrial wastes, *Waste water treatment, *Treatment facilities, *Research and development, *Costs, Pollution abatement.
Identifiers: *Federal programs, *Federal grants, Joint industrial-municipal treatment.

Federal water pollution control programs are described with emphasis being placed on the industrial research and development (R and D) program. The program's general objective is to provide each basic industry the demonstrated, developed, and evaluated technology for the abatement or prevention of water pollution. The R and D program involving research, development and demonstration consists of three components: an in-house effort, a grants program and a contract program. More than 80% of the monies available to the FWPCA for R and D are used in the form of grant and contract payments. Industry can now apply for grants which pay as much as 70% of a project cost up to $1 million. The sequence of review for grant proposals is outlined. Several industrial grants are described. Projected schedules of investments in waste treatment facilities by industry and generalized cost ranges for treatment processes for some industries are summarized. It is estimated that industrial waste treatment costs over the next five years will be $2.6 to 4.6 billion. Joint industrial-municipal treatment is another R and D program area. Grants may be awarded for as much as 75% of the estimated reasonable cost of the project while contracts may be awarded for up to 100% of the project cost. (Galwardi-Texas)
W70-08969

WASTE WATER TREATMENT FOR COMPLETE NUTRIENT REMOVAL,
Notre Dame Univ., Ind. Dept. of Civil Engineering.
Wayne F. Echelberger, and Mark W. Tenney.
Water and Sewage Works, Vol 116, No 10, p 396-402, October 1969. 6 fig, 8 ref.

Descriptors: *Waste water treatment, *Nutrients, *Pilot plants, *Nitrogen, *Phosphorus, Treatment facilities, Biological treatment, Activated sludge, Nitrification, Denitrification, Indiana.
Identifiers: Chemical treatment, Extended aeration, South Bend.

An integrated treatment scheme consisting of a combination of chemical and biological treatment methods designed for the concurrent removal of both organic and euthrophying pollutants was investigated. A flow diagram of the pilot plant treatment process was outlined. Soluble organic carbon was removed by a high rate activated sludge system followed by an extended aeration system for partial aerobic destruction of biological solids and conversion of all forms of nitrogen to nitrate. Metal ion addition, aluminum or iron was provided in the extended aeration system for phosphate precipitation and for enhancement of the flocculation and settleability of the micro-organisms. Removal of inorganic nitrogen was accomplished by passing the nitrified liquid through an anaerobic contact system that reduced the nitrate nitrogen to nitrogen gas. Methanol was used as a supplemental organic carbon source in the anaerobic contact reactor. Bried aeration of the denitrification reactor effluent released additional nitrogen gas and conditioned the microbial solids for improved settleability prior to ultimate discharge of the treated waste water. A vacuum filtration-incineration process appeared to be the most desirable for the treatment of excess sludge. (Galwardi-Texas)
W70-08970

U-TUBE OXYGENATION OPERATING CHARACTERISTICS,
New Mexico State Univ., Las Cruces.
R. E. Speece, and Jack L. Adams.
Proceedings Industrial Waste Conference, 23, p 195-212, May 1968. 17 fig, 1 tab, 1 ref.

Descriptors: *Aeration, *Oxygenation, *Performance, *Waste water treatment, Headloss, Dissolved oxygen, Water management (Applied), Water treatment.
Identifiers: *Oxygen transfer, *U-tube oxygenation, *Operating characteristics, Parameters.

Oxygen transfer to water is a vital process in water quality management. U-tube oxygenation appears to be the most economical oxygenation system available for saturating water, which is desirable in water and waste water treatment processes, river-oxygenation, reservoir oxygenation and fish hatchery operations. As much as 3000 lbs of oxygen per day per 1000 cu ft can be dissolved in a U-tube aerator. The system can be used in natural situations without outside power requirements for stream re-oxygenation where a small hydraulic head of 3 to 4 ft is available. The inherent advantages of U-tube oxygenation are: (1) a high oxygen transfer coefficient resulting from high rates of surface renewal, (2) a long contact time between the bubbles and the water, and (3) an increased dissolved oxygen deficit caused by increasing the saturation concentration due to the hydrostatic head pressurizing the bubbles. The experimental system used consisted of a 40 ft U-tube aerator supplied with compressed air. The variables considered consisted of air-water ratio, water velocity, diffused depth, U-tube depth, water flow rate, air flow rate, diffuser type and oxygen content of the bubbles. Depths of 40 ft or more and nominal water velocities greater than six fps are favored for the design of a U-tube system. In cases where air is injected, minimum diffuser depths are best. (Galwardi-Texas)
W70-08971

THE RELATIONSHIP OF FLOW CHARACTERISTICS TO CHANGES IN SLUDGE CONSISTENCY,
John Hopkins Univ., Baltimore, Md.; and National Council of the Paper Industry for Air and Stream Improvement, Inc.
William L. Carpenter, and Jack Grossman.
Proceedings Industrial Waste Conference, 23, p 680-690, May 1968. 3 fig, 9 tab, 14 ref.

Descriptors: *Industrial wastes, *Sludge, *Flow measurement, *Flow characteristics, *Flow resistance, Velocity, Headloss, Reynolds number, Pulp wastes, Pulp and paper industry, Waste water treatment.
Identifiers: *Paper mill, Solids content, Fibre content.

The effect of solids concentration, velocity and fibre content of representive paper mill sludges were examined to determine their relationship to pipeline head losses. Nine paper mill sludges representing the major types resulting from mill processes and degree of treatment were selected. The equation of Behn was used to describe the non-Newtonian flow anticipated for the sludges. The fibre content of paper mill sludges was shown to be the single most important factor controlling head loss. At high velocities, sludges containing low fibre or solids content had greater head losses than sludges of high fibre or solids content. A relative change in velocity above three fps produces less relative change in head loss with sludges of high solids or fibre than occurs with sludges of low solids or fibre content. Fibre content ranged from 5 to 61%, solids content ranged from 0.5 to 4.2% and velocities ranged from 0.5 to 10 fps during the experiments. Biological sludges produce greater head losses than primary sludge of corresponding solids and fibre content. (Galwardi-Texas)
W70-08972

PURIFICATION OF STARCH INDUSTRY WASTE WATER,
Carl F. Seyfried.
Proceedings Industrial Waste Conference, 23, p 1103-1119, May 1968. 12 fig, 2 tab, 12 ref.

Descriptors: *Industrail wastes, *Treatment facilities, *Biochemical oxygen demand, *Activated sludge, Performance, Efficiencies, Rice, Potatoes, Wheat, Waste water treatment.
Identifiers: *Starch industry, *Germany, *Characteristics, *Flow diagram, Iron sulphate, Extended aeration.

Treatment systems utilized in Germany for the treatment of starch industrial waste water are described. Water consumption of the starch industry in producing 250,000 tons/year of starch is estimated at 2.64 billion gal/year. Pollution by the starch industry equals more than one million population equivalents per working day. Flow diagrams and waste characteristics of plants producing maize, potatoes, wheat and rice starches are summarized. Spray irrigation of waste water of up to 300 mm/year with a concentration of 220 lb BOD5/acre/day is carried out in a large number of smaller factories. Pilot plant studies showed that an activated sludge system could be used in the treatment of starch wastes but that the addition of iron sulphate was required to lower the sludge volume index. At present a full scale activated sludge system is treating 0.63 MGD of a combined maize and rice starch waste with a BOD5 removal efficiency of 97% at a loading of 2.5 kg/cu m/day. Digester supernatant liquor is utilized instead of iron sulphate as a loading agent for the sludge. For the treatment of potatoe and wheat starch waste waters the double-stage activated sludge process yields better results than the single stage and complete treatment can be achieved only at a very low sludge loading and extended aeration. (Galwardi-Texas)
W70-08973

WHAT THE WASTE WATER PLANT ENGINEER SHOULD KNOW ABOUT CENTRIFUGES,
Pennwalt Corp., Warminster, Pa.
Joseph R. Townsend.
Water and Wastes Engineering, Vol 6, No 11, p 42-44, November 1969. 4 fig, 2 tab.

Descriptors: *Waste water treatment, *Centrifugation, *Performance, Capital costs, Activated sludge.
Identifiers: *Tubular bowl, *Disc, *Decanter, *Solid-bowl basket, Parameters.

The use of centrifuges in waste water treatment has increased significantly in recent years. The principles of centrifugation and the capabilities of four types of centrifuges, tubular bowl, disc, decanter, and solid-bowl basket were discussed. The following parameters were presented for each type of centrifuge, bowl diameter, flow rate, solids infeed, discharged solids, temperature range, pressure range, speed, gravity, motor power required and size of particles removed. Relative performances of the disc, decanter and solid-bowl basket centrifuges on a municipal activated sewage sludge were presented. On the assumption that an 85% recovery of particles in an activated sludge was satisfactory, the capital costs were calculated. The disc centrifuge was found to have the lowest cost per unit capacity. For maximum sludge concentration, the basket type was found to be superior while the decanter centrifuge was found to be potentially economical only when used with chemical treatment. (Galwardi-Texas)
W70-08974

METHODS OF CHARGING FOR THE RECEPTION, TREATMENT AND DISPOSAL OF TOXIC WASTES,
Upper Tame Main Drainage Authority, Birmingham (England).
N. Harkness.
Water Pollution Control, Vol 69, No 3, p 314-320, 1970. 1 fig, 2 tab, 27 ref.

Descriptors: *Control, *Disposal, *Biological treatment, *Toxicity, *Sewage treatment, Biochemical oxygen demand, Biodegradation, Oxygen demand, Pilot plants, Waste water treatment.
Identifiers: Treatability factor, Oxygen uptake.

The methods for the determination of charges for the acceptance, treatment and disposal of toxic wastes are discussed. For the reception of wastes into sewers the methods are likely to be similar to those used for other wastes. The purpose is to determine the effect of toxic wastes on the treatment of sewage and to assesss the costs of accomodating toxic wastes at the works. In the experimental examination of treatment of toxic wastes the main consideration must be the quality of the effluent produced. Small scale experimental treatment plants have provided a basis for determining the effect of toxic wastes on the treatment of sewage taking into account adaptation to the waste, reduced purification of sewage due to toxic effects, and the additional treatment of biodegradable constituents. In situations where pilot or laboratory treatment unit experiments are not warranted, then consideration of oxygen uptake by sewage with and without toxic wastes, and if appropriate, the organic content of the toxic waste relative to sewage, may provide a basis for determining a charge for acceptance of toxic wastes. (Sharkar-Texas)
W70-08975

TRISODIUM NITRILOTRIACETATE AND ALGAE,
Ontario Water Resources Commission, Toronto.
A. E. Christie.
Water and Sewage Works, Vol 117, No 2, p 58-59, February 1970.

Descriptors: *Algae, *Activated sludge, *Toxicity, *Laboratory tests, Detergents, Waste water treatment.

Identifiers: *Trisodium nitrilotriacetate, *Chlorella pyrenoidosa, Source of nitrogen, NTA.

The relationships between trisodium nitrilotriacetate, a potential detergent builder, and the algae Chlorella pyrenoidosa were investigated, in an acclimated activated sludge system, with respect to toxicity and as a source of nitrogen both before and after treatment of the material. It was reported that trisodium nitrilotriacetate is non-toxic to fish at concentrations up to 100 mg/l, to mammals fed up to several thousand milligrams per kilogram body weight, and non-irritating to human skin. Results indicated that NTANa3 at concentrations up to 275 mg/l was not toxic to the test organism Chlorella pyrenoidosa and could act as a source of nitrogen for algal growth, although, not to the same extent as equivalent quantities of nitrogen, fed as nitrate, under the same test conditions. Treatment of 275 mg/l NTANa3 by an acclimatized activated sludge system did not reduce the algal growth potential of the chemical. The feasibility of using biodegradable organic materials which contain neither nitrogen or phosphorus as detergent builders should be thoroughly considered. (Galwardi-Texas)
W70-08976

HEAT TREATMENT OF SEWAGE SLUDGES,
University Coll. of South Wales and Monmouthshire, Cardiff. Dept. of Mechanical Engineering.
R. B. Brooks.
Water Pollution Control, Vol 69, p 221-231, 1970. 11 fig, 6 tab, 8 ref.

Descriptors: *Heat treatment, *Sewage sludge, *Chemical oxygen demand, Dissolved solid, Biological treatment, Additives, Solvent extraction, Evaporation, Nitrogen, Ammonia, Sewage treatment, Waste water treatment.
Identifiers: *Liquor, *Full scale plant, *Laboratory treatment, Calorific value.

The object of the work was to obtain data which could be used to predict both the degree of sludge conditioning and the type of liquor produced from a variety of sludges in a full-scale plant. A comparison is made between laboratory and full-scale treatment. The laboratory results were similar in all respects to those of full-scale operation. Comparison of activated sludges from different localities conditioned to the same extent gave similar liquors when heat treated. The concentrations of individual components in a heat treatment liquor increased in proportion to the feed solids concentration. The COD was related to the dissolved solids (DS) by the relationship COD=1.234 + 2026 (mg/l). The organic N content of heat treated liquor was proportional to the DS, there being one relationship for activated sludge and others for humus, primary, activated and digested sludges. The production of ammonia N as a percentage of the total soluble nitrogen, increases with reaction temperature and holding time. Reference is made to the use of activated carbon, coal, and additives. The calorific value of heat treated sludge was slightly higher than that of untreated sludge. Calculations have shown that all the potential heat is recovered from a sludge. A 3% sludge feed could produce a thermally self sustaining process. (Shankar-Texas)
W70-08978

METABOLISM OF SUSPENDED MATTER IN ACTIVATED SLUDGE TREATMENT,
Nagoya City Water Works and Sewerage Bureau (Japan).
Shunzo Takahashi, Toshihiko Fujita, Michio Kato, and Takashi Saiki.
Advances in Water Pollution Research, Proceedings, Fourth International Conference on Water Pollution Research, Sec II, Paper 3, Prague, Apr 21-25, 1969, London, Pergamon Press, 1969, p 341-360, September 1968. 12 p, 8 fig, 4 tab, 11 ref.

Descriptors: *Activated sludge, *Biological treatment, *Metabolism, *Suspended load, Adsorption, Bacteria, Colloids, Effects, Waste water treatment, Sewage treatment.
Identifiers: *Suspended solids, Mixed liquor suspended solids, Soluble matter.

The purification mechanism of sewage by activated sludge is classified into: (a) removal and metabolism of suspended and colloidal matters; (b) adsorption, absorption, and metabolism of soluble matter. Although much work has been done on the latter, very little is known about the metabolism of the former. The proportion of suspended and colloidal organic matter in the toal organic matter in sewage is high; 60% of the total volatile solids and 76% of the total COD of raw sewage is contributed by this fraction. The results described show that under the condition of 4000 mg/l MLSS, and feeding every 4 hours, proteinaceous suspended matter (4 microns - 1 micron) was metabolized by 42% during 20 hours. Proteinaceous suspended matter (60 microns - 4 microns) was metabolized by 30% during 20 hours. Proteinaceous suspended matter (2mm- 60 microns) was hardly metabolized during 20 hours. The adsorption activity of activated sludge was decreased by adsorption of colloids and was recovered by metabolizing these colloids and bacterial growth. Suspended matter did not inhibit the adsorption or absorption of soluble matter by activated sludge. Soluble matter was not released into the liquid phase by metabolizing suspended matter. Suspended matter accelerated the metabolism of soluble matter by activated sludge. The effect of soluble matter on the metabolism of suspended matter depended on the soluble substrate and the condition of the activated sludge. Both bacteria and protozoa metabolize suspended matter. (Aguirre-Texas)
W70-08979

NUTRIENT REMOVAL FROM SEWAGE EFFLUENTS BY ALGAL ACTIVITY,
National Inst. for Water Research, Pretoria (South Africa).
J. Hemens, and G. J. Stander.
Advances in Water Pollution Research, Proceedings, Fourth International Conference on Water Pollution Research, Prague, Apr 21-25, 1969, London, Pergamon Press, 1969, p 701-716.

Descriptors: *Algae, *Hydrogen ion concentration, *Nutrients, *Tertiary treatment, Biological treatment, Nitrogen, Phosphorus, Sewage effluents.
Identifiers: *Algal activity, *Nutrient removal.

Results obtained in removing nitrogen and phosphorus from sewage effluent based on a modification of the methods reported by other workers is described. The results suggest that instead of attempting to remove nutrients from sewage effluent by assimilation into new algal cells it may be more practical, under suitable climatic conditions, to exploit the effects of pH increase due to algal photosynthesis and to avoid the problems of light utilization by dense algal cultures. The basic requirements for this system would be a level of photosynthesis sufficient to produce the pH increase required to precipitate phosphate and to promote loss of ammonia to the atmosphere. The decrease in ammonia and phosphate removal observed during the night might be overcome by the provision of sufficient fluorescent light above the experimental discs to lessen the pH decrease. Alternatively, pH control by the addition of alkaki might be possible, particularly since it was observed that the reduction in alkalinity during daylight reduced the amount of lime required to reach a pH of 10.3 by as much as 75% when compared to that necessary to achieve the same increase in the untreated effluent. (Aguirre-Texas)
W70-08980

LINEAR SUBSTRATE REMOVAL IN THE ACTIVATED SLUDGE PROCESS,
Texas Univ., Austin.
Lial F. Tischler, and W. Wesley Eckenfelder, Jr.
Advances in Water Pollution Research, Proceedings, Fourth International Conference on Water Pollution Research, Prague, April 21-25, 1969, London, Pergamon Press, 1969, p 361-384.

Descriptors: *Activated sludge, *Kinetics, Biological treatment, Chemical oxygen demand, Cultures, Organic matter, Rates, Sewage treatment, Waste water treatment.
Identifiers: Linear substrate removal, Soluble substrate.

Removal of mixtures of various simple organic compounds was investigated using mixed biological cultures in an effort to predict the kinetics of the activated sludge process. The simple organic compounds glucose, phenol, and analine were all removed linearly (zero order) by an activated sludge acclimated to a mixture of the compounds. Variation of the initial concentration of each compound had no effect on the removal rate of the compound by a given sludge. The removal rates of the compounds in a unit containing a mixture of the three, were the same as the rates found when each compound was tested alone. This indicates that different types of organisms may be responsible for the removal of each simple substrate. The predominant type of microorganism present in the continuous activated sludge unit was determined by the organic loading level on the unit. A filamentous sludge, found at higher loadings, was capable of assimilating glucose and phenol at significantly greater rates per unit biological solids than the flocculant sludges found at low and intermediate organic loadings. The linear removal rate for each compound increased linearly with increasing biological solids concentration. Overall organic removal, as measured by COD or TOC from a mixture of three or five linearly-removed simple compounds by an activated sludge acclimated to these compounds is actually a summation of the removals of each of the simple compounds. The removal of these mixtures can approximate first order kinetics. (Aguirre-Texas)
W70-08981

THE SUCCESSION OF MICROBIAL PROCESSES IN THE ANAEROBIC DECOMPOSITION OF ORGANIC COMPOUNDS,
Hydraulic Research Inst., Prague (Czechoslovakia).
Jiri Hausler.
Advances in Water Pollution Research, Proceedings, Fourth International Conference on Water Pollution Research, Prague, April 21-25, 1969, London, Pergamon Press, 1969, p 407-426.

Descriptors: *Anaerobic digestion, *Metabolism, *Organic compounds, Acid bacteria, Anaerobic bacteria, Bacteria, Biological treatment, Fermentation, Methane bacteria, Waste water treatment, Sewage treatment.
Identifiers: *Microbial processes.

In the biological methane production, it was assumed that methane and carbon dioxide resulted from the fermentation of cellulose due to the activity of only one species of microorganism-Bacillus omelianskii. Later it was shown that the production of methane is the result of complicated microbial processes occurring in several stages. Insufficient attention seems to have been paid to the succession of these microbial processes of methane digestion. In industrial wastes with a high carbohydrate content (more than 2 g/l), butyric fermentation predominates during the first stage of methane digestion. Acetic and butyric acids are produced as well as CO_2 and CH_4 in the ratio of 1:1. In the second stage the main products are acetic, propionic and butyric acids. In this stage three successive characteristic processes can be observed: (a) The butyric acid is decomposed by beta-oxidation to acetic acid. (b) Acetic acid is decomposed mainly by Methanosarcina methani to CO_2 and CH_4. (c) The last step is the degradation of propionic acid to acetic acid. This process is due to the activity of Methanobacterium propionicum. The acetic acid is then further decomposed to CO_2

and CH4. A new method for anaerobic treatment of industrial wastes with high carbohydrate content is suggested. The method is based on the fact that the whole process follows a natural succession divided into several physiological stages, with each stage taking place in a separate digester thus preventing antagonism between the specific species of microorganisms. After the acid digestion, the effluent must be neutralized with lime. (Aguirre-Texas)
W70-08982

THE PATHWAYS OF PHOSPHORUS IN BIOLOGICAL TREATMENT PROCESSES,
California Univ., Berkeley.
David Jenkins, and Arnold B. Menar.
Advances in Water Pollution Research, Proceedings, Fourth International Conference on Water Pollution Research, Prague, April 21-25, 1969, London, Pergamon Press, 1969, p 677-700.

Descriptors: *Biological treatment, *Phosphorus, Metabolism, Nutrients, Phosphates, Waste water treatment, Sewage treatment, Detergents.
Identifiers: *Pathways, *Phosphorus removal, Mechanisms, Sources.

In a residential community the synthetic detergent contribution to raw sewage phosphorus is between 60-67%. In primary sedimentation phosphorus removal is between 5-15%. The primary sludge contains between 0.61 and 0.72% P on a dry weight basis. Activated sludge from systems with organic removal rates in the range of 0.1-42.5 lb COD/lb VSS/day contained 2.62% P on a volatile solids basis. From a determination of the yield, endogenous decay rate, sludge phosphorus content and variation of removal efficiency with loading it was concluded that phosphorus removal by biological means would always be 20% or less for an influent phosphorus concentration of 9 mg/l P. At low loadings the phosphorus removal would be less than 20% because of the increased significance of endogenous respiration in determining the net growth in the system. Chemical precipitation as a calcium phosphate followed by sorption on the activated sludge floc has been suggested as a mechanism for the enhanced phosphorus removal observed at plants such as San Antonio, Texas. The equilibrium phosphorus content of sewages could be accurately predicted by assuming the precipitation of CaHPO4 (K sub sp = 2.2 x 10 to the minus 7th power). (Aguirre-Texas)
W70-08983

THE INFLUENCE OF INCREASED TEMPERATURES (30-39 DEG) ON THE BIOCOENOSIS OF ACTIVATED SLUDGE AND THE INTENSITY OF DECOMPOSITION OF ORGANIC COMPOUNDS,
C. Rogovskaya, M. Lagareva, and L. Kostina.
Advances in Water Pollution Research, Proceedings, Fourth International Conference on Water Pollution Research, Prague, April 21-25, 1969, London, Pergamon Press, 1969, p 465-476.

Descriptors: *Activated sludge, *Effects, *Temperature, Biodegradation, Biological treatment, Industrial wastes, Organic compounds.
Identifiers: Biocoenosis.

The influence of increased temperatures of the medium was studied considering the following factors: (1) the biochemical oxidation of organic compounds which are often found in industrial wastes-formaldehyde, acetone, and phenol; (2) the composition of the microfauna of activated sludge and its microflora according to physiological groups and the identification of bacteria; (3) activated sludge yield; (4) sludge index; (5) settlement of the suspended matter in the secondary sedimentation tank; (6) nitrification; and (7) the air used when the concentration of dissolved oxygen in the secondary sedimentation tank was 2.5-3.0 mg/l. The purification of industrial wastes under increased temperatures (up to 39 deg C) is possible. An increase in temperature causes the size of the bacterial cells and the specific composition of microflora and microfauna to decrease. The adaptation of bacteria to increased temperatures was slower than the adaptation to toxic compounds. The optimal temperature for nitrifying bacteria was 30-35 deg C. With an increase in temperature the number of microfauna species of the active sludge decreased (from 21 species at 20 deg C to 4-5 at 39 deg C). The growth of sludge decreases with an increase in temperature (sludge treating 600 mg/l formaldehyde) at 32 deg C did not produce excess sludge. With a rise in temperature the sludge index had a tendency to increase (from 56 ml/g at 20 deg C to 93 ml/g at 39 deg C). Wash-out of suspended particles from the secondary sedimentation tank was inconsequential at all temperatures studied, but it tended to decrease with a rise in temperature. The biochemical activity of sludge increased with a rise in temperature (0.916 g BOD removed per gram of sludge/day at 39 deg C and 0.597 g at 20 deg C). (Aguirre-Texas)
W70-08984

RECOVERY OF POLLUTED WATER,
Ontario Water Resources Commission, Toronto.
Great Lakes Water Quality Surveys Program.
For primary bibliographic entry see Field 05G.
W70-08988

WATER SUPPLY AUGMENTATION BY REUSE,
Utah Water Research Lab., Logan.
David W. Hendricks, and Jay M. Bagley.
In: Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association, Urbana, Illinois, p 247-259, 1969. 5 fig, 1 tab, 6 ref.

Descriptors: *Water reuse, *Water resources development, *Planning, Water yield improvement, Water supply, Conjunctive use, Reclaimed water, Water conservation, Water treatment, Water utilization, Water demand.
Identifiers: Water recycling.

Development of water supplies should include considerations of recycling as an intensive option to be thoroughly explored prior to adoption of an extensive option, usually large scale transport. The potential of recycle is examined as a formal option in water resources planning. Major emphasis is on the conceptual aspects of recycle in the water planning context; the concept is illustrated by means of a case study for an arid region having both large non-consumptive and large consumptive diversions. (See also W70-08597)
W70-08999

5F. Water Treatment and Quality Alteration

REVERSE OSMOSIS CAN CUT COST OF WATER TREATMENT,
Gulf General Atomic, Inc., San Diego, Calif.
J. H. Meyers.
Industrial Water Engineering, Vol 7, No 3, p 25-30, March 1970. 3 fig, 4 tab.

Descriptors: *Optimization, *Design, *Economic feasibility, *Reverse osmosis, *Water treatment, *Costs, Water quality control, Demineralization.

The mass production of uniform-quality membranes was said to be the main item responsible for the popularity and competitiveness of installation of industrial reverse osmosis. The membrane as the heart of the RO system had the characteristics of permitting the passage of water while acting as a barrier to the passage of dissolved or suspended solids. Long-term performance was basic to the value of the reverse osmosis system and it was important that the total installation, including pretreatment, be designed for optimum performance and high availability. In-plant experience gathered over the past two years served as a basis to help insure good overall design and determine economic feasibility. The primary factors that determined performance of reverse osmosis were: (1) applied pressure; (2) concentration of the dissolved solids in the feed; (3) temperature of the feed; and (4) the porosity or permeability of the membrane. To assure optimum performance over long periods the feed was pretreatd by filtration and chemical addition. The major use for reverse osmosis was for the production of high-purity demineralized water. The application offered flexibility in producing water of many qualities for various plant requirements. The components of the RO system installation were described. The capital and operating costs of reverse osmosis equipment decreased significantly as size increased. Typical capital and operating costs for a range of capacities were shown. (Kriss-Cornell)
W70-08851

APPLICATION OF MICROSTRAINER TO WATER TREATMENT AT NAGPUR (INDIA),
Central Public Health Engineering Research Inst., Ahmedabad (India).
M. Parabrahman, J. S. S. Lakshiminarayana, and M. V. Bopardikar.
Water Research, Vol 1, No 3, p 225-231, March 1968. 1 fig, 6 tab, 7 ref.

Descriptors: *Water treatment, *Phytoplankton, Turbidity, Diatoms, Efficiency, Chlorine.
Identifiers: *Microstrainer, *Suspended solids, *Algal counts, *Quality, Filtrability index.

The efficacy is dealt with of microstraining in the treatment of lake waters for drinking purposes. One Glenfield Standard unit, having a drum 2 1/2 ft. diameter and 2 ft wide enclosed by a mild steel tank was installed on the bank of Ambazari lake (India). The flow of wash water as well as microstrained water was measured with 'V' Notchweirs. Analyses and the methods employed were similar to APHA Standard methods, 1955. Filtrameter was used to determine the filtrability index (FI) and Laemocytometer was used for algal counts. There were no differences in pH, chlorides, and alkalinity between raw and microstrained waters tested. On an average, the turbidity of the water varied from 10.4 to 500 ppm and that of microstrained water from 7 to 2 ppm. The percentage reductions in suspended solids due to microstraining ranged from a minimum of 8.3 to 8.7. The average monthly reduction in FI ranged from 62.7 to 81.5. The percentage reduction in algal growth due to microstraining varied from 75 to 94. On the whole, microstraining works well for algae removal. Reduction in the chlorine demand of the raw water was noted if it was microstrained. (Shankar-Texas)
W70-08898

SEPARATION OF PHENOLS IN WATERS BY THIN LAYER CHROMATOGRAPHY,
National Research Centre, Cairo (Egypt). Water Pollution Dept.
Osman M. Aly.
Water Research, Vol 2, p 587-595, 1968. 3 fig, 3 tab, 36 ref.

Descriptors: *Phenol, *Chromatography, *Silica, Chlorination, Analytical techniques, *Potable water, Odor, Taste.
Identifiers: *Thin layer, *Technique, *Solvent system, Gel plates, RF values.

The separation of phenol in natural and waste water by thin layer chromatography to erradicate the objectionable taste and odors they impart to water especially after chlorination is described. Phenols are separated on thin layers of silica as their 4-aminoantipyrine or p-nitrophenylazo dyes. The antipyrl dyes are prepared by the condensation of phenols with aminoantipyrine in the presence of alkaline oxidizing agents. The azo dyes are prepared by coupling of phenols and p-nitrobenzene diazonium fluoborate. The antipyrine dyes were chromatographed on neutral silica gel plates and p-nitrophenylazo dyes on basic silica gel plates. Plates were developed by the ascending

technique at room temperature. (20-25 deg C). After chromatography, the plates were dried and the spots were colored. Solvent systems used in the technique are listed. The RF values of 4 aminoantipyrine derivatives of various phenol and p-nitrophenylazo dyes derived from different phenols are presented. It is concluded that a wide variety of phenols could be separated and identified by combination of two methods. The above technique was used for the identification of chlorination products of phenols in waters. (Shankar-Texas)
W70-08901

PROSPECTS FOR TREATING WATER FROM NUCLEAR ELECTRIC POWER STATIONS WITH PULVERIZED IONITES,
O. I. Martynova, N. P. Subbotina, and A. S. Kopylov.
Available from the Clearinghouse as JPRS-49539, $3.00 in paper copy, $0.65 in microfiche. Translated from Atomnaya Energiya. Translation JPRS-49539 2 Jan 70, 9 p, 9 ref.

Descriptors: Nuclear power plants, *Radioactive wastes, Filters, Ion exchange, Resins.
Identifiers: Ionites, USSR.

The purification of reactor water at atomic power stations whose principal purpose is the removal of corrosion products forming in the first loop and reducing the radioactivity of water, must ensure the removal of impurities present in coarsely dispersed, colloidal and ionized states, and therefore provision is made for both the clarification and ionization of water. Thus a discussion of the use of ionite filters is presented.
W70-09007

5G. Water Quality Control

WATERS FOR WATERFLOODING SAN JOAQUIN VALLEY, CALIF, PETROLEUM RESERVOIRS,
Bureau of Mines, San Francisco, Calif. Petroleum Research Office.
For primary bibliographic entry see Field 02K.
W70-08587

ADVANCES IN WATER POLLUTION RESEARCH.

Proceedings 4th International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, 1969. 936 p.

Descriptors: *Water resources, *Water pollution control, *Research equipment, *Analytical techniques, Water quality, Dissolved oxygen, Biochemical oxygen demand, Suspended load, Wastes, Sewage, Algae, Microorganisms, Phosphates, Hydrogenation, Aeration, Flocculation, Filtration, Model studies, Computers, Nutrients, Eutrophication.
Identifiers: *Water pollution research.

This volume contains the 53 original papers presented at the Fourth International Conference on Water Pollution Research held in Prague in April, 1969. Among the topics discussed are the self-purification of polluted rivers that have been artificially canalized, the factors that influence pollution under these conditions, and methods for predicting the extent of pollution and the distribution of dissolved oxygen in rivers. Computers may be used to analyze various alternative means of obtaining river water of required quality. The most important contribution towards pollution control is made by purifying sewage and other waste water. Purified sewage is an important source of the mineral nutrient requirements of microrganisms especially algae, and pollution control must include nutrient removal from effluents. (Woodard-USGS)
W70-08627

THE COURSE OF SELF-PURIFICATION PROCESS OF CANALIZED HIGHLY POLLUTED RIVERS,
Water Protection Research Section, Breslau (Poland).
Henry Manczak.
In: Advances in Water Pollution Research, Proceedings 4th International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, p 1-13, 1969. 13 p, 10 fig, 14 ref, append.

Descriptors: *Self-purification, *Canals, *Water pollution, *Rivers, Impounded waters, Ice, Low flow, Biochemical oxygen demand, Dissolved oxygen, Equations, Path of pollutants, Streamflow.
Identifiers: Odra River (Poland).

The Odra River in Poland has a canalized water course during the navigable season, and is a free-flowing natural river in the post-navigable period. These circumstances made it possible to study the differences in self-purification of an impounded and free-flowing water course at the time of ice covering, when the river is free of ice, and also during low flow in the summer with a higher water temperature. Within a distance of 264 km along the river, 120 control stations were located, where 1440 samples were taken. The time of passage had been previously determined by means of a radioactive tracer (Br-82). (Woodard-USGS)
W70-08629

BOUNDARY LAYER EFFECT ON THE COURSE OF THE SELF-PURIFICATION OF SMALL STREAMS,
Hydraulic Research Inst., Brno (Czechoslovakia).
Vladimir Novotny.
In: Advances in Water Pollution Research, Proceedings 4th International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, p 39-50, 1969. 12 p, 3 fig, 3 tab, 18 ref.

Descriptors: *Water pollution, *Boundary layers, *Effects, *Self-purification, *Streams, Mass transfer, Oxygen, Diffusion, Streambeds, Banks, Foreign research.
Identifiers: Deoxygenation coefficient, Czechoslovakia.

The relationship between the deoxygenation coefficient of rivers and the hydraulic conditions of flow was studied. Every mass transfer between benthic organisms and flowing water must take place through the diffusive boundary later. The velocity of the slowest process during the mass transfer is then the limiting factor for the intensity of the biochemical activity of these organisms; this also determines whether the processes in the benthal layer are aerobic or anaerobic. In the same way changes of the chemical composition of water may be explained. The classification of rivers into categories according to the degree of self-purification makes it possible to compare values for the deoxygenation coefficient in observation and theory in order to test whether the relationships obtained are in good agreement with reality. (Woodard-USGS)
W70-08631

WATER QUALITY PROTECTION PLANS IN RIVER BASINS,
Institute of Hydrotechnical Research, Bucharest (Rumania). Surface Water Lab.
Radu Antoniu.
In: Advances in Water Pollution Research, Proceedings 4th International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969; London, Pergamon Press, Ltd, p 23-29, 1969. 7 p, 3 fig, 7 ref.

Descriptors: *Water quality control, *Watershed management, *River basins, *Standards, *Legislation, Water pollution, Biochemical oxygen demand, Dissolved oxygen, Foreign research, Water management (Applied), Water law.
Identifiers: *Romania.

In Romania, a law was enacted on 'Quality Conditions of Surface Waters' to initiate the elaboration of plans for protection of water quality in the river basins of the country. The scientific basis for control measures in the water quality protection is provided by research conducted since 1960 in the Surface Water Laboratory at the Institute of Hydrotechnical Research, Bucharest. These investigations include physical, chemical, biological and bacteriological studies in the main river basins of the country, and the development of new standards and guidelines. Categories in determining the water quality requirements of a stream are potable water supplies; water used for urban or recreation purposes; and irrigation and industrial water supplies. The basic indicators used in water quality protection plans for the rivers Olt, Arges, and Siret were 5-day biochemical oxygen demand, dissolved oxygen, and toxic substances. A drawing showing major water uses and sources of pollution in the Olt River Basin and a graph showing values of BOD and DO proposed for the year 1980 are included. (Woodard-USGS)
W70-08632

STREAM REAERATION USING MOLECULAR OXYGEN,
Crown Zellerbach Corp., Camas, Wash. Dept. of Manufacturing Services.
Herman R. Amberg.
In: Advances in Water Pollution Research, Proceedings 4th International Conference on Water Pollution Research, held in Prague, Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, p 291-298, 1969. 8 p, 2 fig, 3 tab, 5 ref.

Descriptors: *Reaeration, *Dissolved oxygen, *Oxygenation, *Streams, Diffusion, Application methods, Feasibility, Costs, Oregon, Louisiana, Water pollution treatment, Water pollution control, Water quality control.
Identifiers: *Molecular oxygen.

Experiments were designed to determine the feasibility of adding substantial quantities of dissolved oxygen to streams by means of two different aeration methods. In the Willamette River in Oregon, molecular oxygen was vented into the water passing through a power turbine. In the Pearl River in Louisiana oxygen was diffused through a multiport header on the bottom of the stream. Addition of oxygen to a power turbine resulted in oxygen absorption efficiencies of 39% when the water coming to the turbine was 81% saturated. Addition of oxygen to the turbine was relatively simple and inexpensive, whereas the use of a diffuser header resulted in a much lower oxygen absorption efficiency and was much more complicated and expensive. It is doubtful whether oxygen absorption efficiencies in excess of 20% can be attained with a well designed diffuser header placed along the stream bottom. Oxygen requirements and costs for various oxygen addition rates for power turbine and aeration header applications are tabulated. (Woodard-USGS)
W70-08644

INVESTIGATIONS OF THE RESIDUES OF CHLORINATED INSECTICIDES IN GROUNDWATER (In Italian),
Florence Univ. (Italy). Inst. of Hygiene.
For primary bibliographic entry see Field 05B.
W70-08659

RESEARCH OF THE RESIDUES OF CHLORINATED INSECTICIDES IN THE SURFACE WATER USED FOR DRINKING (In Italian),
Florence Univ. (Italy). Inst. of Hygiene.
For primary bibliographic entry see Field 05B.
W70-08660

COLE V PENNSYLVANIA PUB UTIL COMM'N (ADMINISTRATIVE CONTROL OF WATER SUPPLY AND QUALITY).

146 Pa Super 257, 23 A2d 121-124 (1941).

Descriptors: *Pennsylvania, *Regulation, *Water supply, *Administrative agencies, Utilities, Water works, Pipes, Reservoirs, Filtration, Pumping, Costs, Judicial decisions, Legal aspects, Water management (Applied), Water purification, Filters, Public health, Permits, Water quality control, Administrative decisions, Water treatment.

Plaintiffs were receiving raw, unfiltered water from a water supply company at little or no cost. The water company's permit from defendant Public Utility Commission to supply water was given upon condition that all water supplied be filtered. Plaintiffs were connected into the company's mains at a point above its filtration plant. Upon discovery of non-compliance with the permit and refusal of the water company to build a line back from its filtration plant which would enable plaintiffs to receive filtered water, defendant ordered plaintiffs' water supply discontinued. Plaintiffs asked defendant to require the water company to continue service to them. The Commission held that it was unlawful for the company to serve unfiltered water to the public and that it was unreasonable, in light of the expense involved, to require the company to serve filtered water to plaintiffs. Plaintiffs appealed to the superior court, which held that the question to be decided was an administrative one which was within the sound judgment and discretion of defendant, and its decision, which was based upon substantial evidence, was not to be disturbed. (Barnett-Florida)
W70-08664

ANNEBERG V KURTZ (RIGHT TO MAINTAIN A PRIVATE NUISANCE OBTAINED BY PRESCRIPTION).
28 SE2d 769-773 (Ga 1944).

Descriptors: *Georgia, *Prescriptive rights, *Canneries, *Pollution abatement, Easements, Downstream, Non-navigable waters, Decomposing organic matter, Legal aspects, Relative rights, Riparian rights, Riparian waters, Watercourses (Legal), Legislation, Disposal, Pollutants, Water pollution effects, Water pollution sources, Mills, Damages, Remedies.
Identifiers: *Nuisance (Private).

Plaintiff lower riparian landowner sought to enjoin defendant upper riparian cannery from polluting the non-navigable stream flowing across both lands. Plaintiff also sought damages alleged to have occurred from the resultant interference with operation of her grist mill. Defendant, who had discarded tomato peels and other debris into the stream for thirty-three years, contended he had thereby acquired a prescriptive right to so sue the stream and the land through which it flowed. The appellate court held that the right to maintain a private nuisance can be acquired by prescription and that the defendant had acquired such a prescriptive right. The decree appealed from was affirmed. (Price-Florida)
W70-08680

PLANNING FOR WATER QUALITY EMERGENCIES,
For primary bibliographic entry see Field 06E.
W70-08800

THE USE OF DIGITAL SYSTEMS MODELING IN THE EVALUATION OF REGIONAL WATER QUALITY INVOLVING SINGLE OR MULTIPLE RELEASES,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 05B.
W70-08828

THERMAL POLLUTION, THE SHARP HORNS OF A NATIONAL DILEMMA,
Consolidated Edison Co. of New York, Inc., New York.
Charles F. Luce.
Water Spectrum, Vol 2, No 2, p 19-23, Summer 1970. 3 fig.

Descriptors: *Thermal pollution, *Electric power industry, *Electric power demand, *Cooling water, *Impaired water quality, Environment, Ecology, Powerplants, Water cooling.
Identifiers: *Closed cycle dry cooling.

Dealing with increasing thermal pollution problems, the author had nine propositions as follows: (1) We must protect the quality of waters. (2) The Nation's demand for electric energy will continue to increase at a rapid rate and this demand must be met. (3) To some extent, to build a power supply will impinge upon the environment. (4) The question of how much alternation of the ecology we are willing to accept as the price of a new power supply is the key question. (5) The resolution of tese questions should be the same whether the electric utility is investor-owned or publicly owned. (6) Nuclear generating stations do not present a new thermal discharge problem. (7) In meeting the power demand, the cooling capacity of many waters will be exceeded in the near future. (8) Eventually it will be necessary to develop closed cycle dry cooling devices. (9) Research is needed in developing less expensive and less bulky cooling facilities. It is emphasized that it is important to determine the actual ecological changes caused by thermal discharge. (Osborne-Vanderbilt)
W70-08829

USES OF WASTE HEAT,
Oak Ridge National Lab., Tenn.
Sam E. Beall.
Oak Ridge National Laboratory Review, Vol 3, No 4, p 9-14, Spring 1970.

Descriptors: *Thermal pollution, *Greenhouses, Water temperature, Powerplants, Distillation, Algae, Aquiculture, Fish, Shellfish, Crustaceans, Oysters, Seasonal.
Identifiers: *Waste heat, Thermal efficiency, Heat consumption.

Waste heat from powerplants which would normally add to the problem of thermal pollution can be reused for a profit. One use of this waste heat would be as a substitute for electricity in low-temperature industrial uses. Waste heat can be used for air cooling in ammonia or lithium bromide air conditioning systems during the summer when thermal releases need to be reduced the most. Another use of waste heat would be in the evaporation of waste water to allow reuse of the valuable water. Similarly, distillation of salt water or brackish water could make use of waste heat. The best possible use would be in the heating and cooling of greenhouses and poultry houses located on the reactor exclusion area. However, aquiculture pond heating promises large profits in the high yields of fish, shellfish, and crustaceans. Further study on the subject of waste heat reuse is being done in the Pacific Northwest where irrigation uses are being considered. (Osborne-Vanderbilt)
W70-08832

COMPUTER MODEL OF CONNECTICUT RIVER POLLUTION,
United Aircraft Corp., East Hartford, Conn. Research Labs.
Thomas E. Hoover, and Robert A. Arnoldi.
Journal of Water Pollution Control Federation, Vol 42, No 2, Part 2, p R67-R75, Feb 1970. 4 fig, 1 tab, 11 ref.

Descriptors: *Computer models, *Pollutant identification, *Biochemical oxygen demand, *Dissolved oxygen, *Temperature, Connecticut, Physical properties, Equations, *Digital Computers, Delaware River, *Mathematical models, *Simulation analysis.

The object of the study was to adapt the Deleware River program to produce a computer model of the Connecticut River within the state of Connecticut. This model would make use of the best information available describing physical conditions, such as flow volumes and sounding depths, as well as the latest pollution data describing DO, BOD, and temperature. Such a model made it possible to predict the effect of waste water input, artificial aeration, and temperature on the overall water purity. Equations describing aeration, photosynthesis, and bacterial decay were used in the model to calculate changes in DO and BOD concentrations in time. For model construction, the river was partitioned along its length into thirty-nine sections, each of which was assumed to be completely mixed with a uniform concentration of DO and BOD. This made it possible to use a simple one-dimensional mathematical model suited ideally to digital computation. The predicted DO and BOD concentrations in the Connecticut were presented. (Kriss-Cornell)
W70-08843

EVALUATION OF ALTERNATIVE SOLUTIONS FOR ACHIEVEMENT OF RIVER STANDARDS,
Quirk, Lawler and Matusky, New York.
Thomas P. Quirk, and Leonard J. Eder.
Journal of Water Pollution Control Federation, Vol 42, No 2, Part 1, p 272-290, Feb 1970. 16 fig, 3 tab.

Descriptors: *Mathematical models, *Computers, *Simulation analysis, *Water quality control, *River systems, Biochemical Oxygen demand, Dissolved oxygen.

The objectives of the study were: (1) the determination of the river's physical characteristics; (2) development of a mathematical simulation model of the river to predict BOD and DO profiles under any condition of flow, temperature, or waste discharge; (3) application of the simulation model to investigate in detail: (a) BOD assimilation capacity under critical weather and flow conditions and (b) the effects of sludge deposits, hydro-turbine venting and flow augmentation; (4) development of the comparative economics of alternative solutions for achievement of proposed water quality standards. The river studied was approximately 170 miles (274 km) in length with a drainage area of 3,500 sq miles (9,065 km). The major river characteristics involved were summarized. The composite effect yielded a discontinious river system physically, hydraulically, and biologically, requiring lengthy calculations for manual determination of assimilation capacity. Development of a mathematical simulation model and computer solution was indicated. A system analysis approach was utilized and the general procedure was described. Component models for oxygen input and oxygen consumption was shown and were grouped in terms of the basis used for flow regimen description. A composite model for river simulation was constructed by summing the components shown and the simulation as seen by the computer was illustrated. (Kriss-Cornell)
W70-08846

ECONOMICS OF THERMAL DISCHARGES,
Colorado State Univ., Fort Collins.
George Lof, and John Ward.
Industrial Water Engineering, Vol 7, No 1, p 12-18, Jan 1970. 5 fig, 10 ref.

Descriptors: *Economics, *Downstream, *Cooling water, Water quality, Chemicals, *Capital costs, *Operating costs, *Temperature.
Identifiers: *Thermal discharges.

Economic implications of thermal discharges were examined. The discharges from power plants and the potential effect that the discharges have on downstream water-users, that is, on downstream water used for cooling purposes, were described. It was pointed out in the literature that the temperature of water used for cooling purposes was often of more significance that the composition and chemical quality of water. The main objective was to indicate the approximate range of costs involved in

completely preventing thermal discharge; i.e., by circulating water through cooling towers, and to show the approximate costs to a downstream power plant being forced to use cooling water containing thermal discharges from an upstream electric station. The cost of cooling water recirculation included capital costs, primarily of the cooling tower installation, and operating costs, which were the make-up water, chemicals, and power for operating fans and pumps. The capital costs were dependent upon water flow required, prevailing wet bulb temperature of the air, the water temperature change through the tower, and the temperature of water delivery from the cooling tower to the condenser. The capital cost of the cooling tower installation was estimated from charts and tables and an example was given. Economic consequences of thermal discharge, such as water loss by evaporation, were discussed. (Kriss-Cornell)
W70-08852

WATER QUALITY CONTROL IN CALIFORNIA,
California State Water Resources Control Board, Sacramento.
Norman B. Hume.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 96, No SA4, Paper 7448, p 873-884, August 1970.

Descriptors: *Water quality control, *Legislation, *California, Water pollution control, Aesthetics, Water law, Water management (Applied), Water pollution, Water quality, Waste disposal.
Identifiers: Water quality legislation.

The Porter-Cologne Water Quality Control Act, effective January 1, 1970, completely revises California's 20 yr-old water pollution control law. Esthetics and protection of fish and wildlife have been added to beneficial uses of water to be protected. Area-wide planning for the solution to water pollution problems is encouraged. The interrelationships of water quality and water quantity as expressed by water rights are recognized. The State Water Resources Control Board now administers the related functions of water rights determination and water quality control. The State Board establishes policy and guidelines for nine Regional Water Quality Control Boards. The regional boards adopt water quality control plans and establish waste discharge requirements to meet the water quality objectives enunciated in the water quality control plans which must be approved by the State Board. Violators of waste discharge requirements may now be assessed civil penalties of up to $6,000 per day for each day of violation. (Knapp-USGS)
W70-08943

MODEL OF NATURAL DRAFT COOLING TOWER PERFORMANCE,
Federal Water Quality Administration, Corvallis, Oreg. Pacific Northwest Water Lab.
For primary bibliographic entry see Field 05D.
W70-08945

RECOVERY OF POLLUTED WATER,
Ontario Water Resources Commission, Toronto. Great Lakes Water Quality Surveys Program.
W. A. Steggles.
In: Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association, Urbana, Illinois, p 163-169. 13 ref.

Descriptors: *Water pollution control, *Economics, *Water quality control, *Water costs, Water management (Applied), Social aspects, Water law, Governments.
Identifiers: St. Lawrence Basin, North America.

Economic and other losses due to pollution in North America are examined including the socio-economic costs of improvements using existing technology. Canadian experiences in the Province of Ontario portion of the Great Lakes-St. Lawrenc Basin are reviewed as an example of the alternatives being considered in water management to bring the forces of improved technology to bear on augmenting the water supply through pollution control. The power and potential of basin-wide water management is considered as a device to achieve the often conflicting objectives of economic growth and maintenance of quality of the environment. (See also W70-08597)
W70-08988

PHYSIOGRAPHY-LAND USE INTERACTIONS IN WATERSHED MANAGEMENT,
British Columbia Univ., Vancouver. Dept. of Forestry.
For primary bibliographic entry see Field 05B.
W70-08989

ELKHART LAKE, WISCONSIN COMPREHENSIVE PLAN.
Wisconsin State Dept. of Local Affairs and Development, Madison. Bureau of Local and Regional Planning.
For primary bibliographic entry see Field 06A.
W70-09004

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

TIME-CAPACITY EXPANSION OF URBAN WATER SYSTEMS,
Stanford Research Inst., Menlo Park, Calif.
Russell F. Scarato.
Water Resources Research Vol 5, p 929-936, October 1969, 8 p, 4 fig, 8 ref.

Descriptors: *Costs, *Capital investment, *Economics, *Water resource development, Water supply, Interest rate, Water demand, Planning, Financing, Budgeting, Water treatment, Capital costs, Rate of growth, Model studies, Technology, Optimization, Cost minimization, Pipelines.
Identifiers: *Economies of scale, *Water investment, *Pipeline size, Discount rate, Excess capacity.

The criteria for providing insight into the timing and capacity expansion decisions of a water facility are developed in this paper. A time-capacity expansion model is applied to two independent decisions: pipelines and water treatment. The model is a general minimum cost types, applied to time and size component expansion needed to meet an exogenously determined water system growth rate. It analyzes the economic impact of both the economies of scale in construction and the real cost of capital. The economic effects of timing and sizing decisions on total costs are plotted for various interest rates and levels of economies of scale. The model used is the one developed by Manne. As adapted by the author, the model shows that capital savings are available in urban water investments by establishing the initial design size and timing specifications of a proposal after quantitatively analyzing the effects of economies of scale and cost of capital under conditions of growth. (Murphy-Rutgers)
W70-08692

AN APPLICATION OF SPATIAL EQUILIBRIUM ANALYSIS TO WATER RESOURCE ALLOCATION,
Guelph Univ. (Ontario); and University of New England, Armidale (Australia).
J. C. Flinn, and J. W. B. Guise.
Water Resources Research Vol 6, No 2, p 398-409, April 1970.

Descriptors: *Water supply, *Prices, *River basin, *Optimization, Model studies, Economic analysis, Distribution, Social aspects, Maximization, Demand, Planning, Marginal cost, Agricultural water, Industrial water, Water pricing, Decision-making.
Identifiers: *Spatial equilibriom, *Social welfare.

The purpose of this paper is to demonstrate that the interregional equilibrium models developed by Takayama and Judge may be adapted to determine the efficient allocation and pricing of water in a river basin. It is assumed that the authority responsible for the allocation and pricing seeks a policy that will ensure that social welfare in relation to the available water supply is maximized. The capacity of the authority to supply water within any time period is assumed to be constrained by the physical structure of the system. The potential usefulness of such a model is demonstrated and the results discussed. The authors show that models of this type have considerable potential for empirical research in the field of water resources. (Murphy-Rutgers)
W70-08693

ECONOMETRICS OF JOINT PRODUCTION: A COMMENT,
Columbia Univ., New York.
V. K. Chetty.
Econometrica, Vol 37, No 4, p 731, October 1969. 1 ref.

Descriptors: Statistical methods, Least squares method, Regression analysis.
Identifiers: *Econometrics, Canonical correlation, Joint production.

In a recent paper, H D Vinod has suggested the use of canonical correlation techniques for the estimation of joint production functions. He has also argued that the least squares estimates of the joint production functions are inconsistent. In this note, it is demonstrated that the canonical correlation and the least squares methods yield the same estimates of the joint production functions, and that his proof of the inconsistency of the least squares estimates is erroneous. This article would be of interest to the water researcher attempting to develop a joint production model for water supply. (Loeb-Rutgers)
W70-08706

A NOTE ON ECONOMETRICS OF JOINT PRODUCTION,
Chicago Univ., Ill.
Potluri Rao.
Econometrica, Vol 37, No 4, p 737-738, October 1969. 3 ref.

Descriptors: Economics, Technology.
Identifiers: *Econometrics, *Joint production, Canonical correlation, Restrictions, Multiple products, Aggregation, Transformation curve.

In a recent paper, H C Vinod suggested a canonical correlations technique for estimating joint production processes. Estimates from such a procedure have economic interpretation only under certain restrictive assumptions. The purpose of this note is to point out these restrictions. Joint production includes two cases: (1) when there are multiple products, each produced under separate production process; and (2) when there is joint production, i.e., when several outputs are produced from a single production process. This may prove useful in the water area when applying econometric methods to estimate relations that reflect the joint production aspect of water supply. (Loeb-Rutgers)
W70-08707

ANALYSIS OF INVESTMENT RETURNS BY COMPUTER,
Michigan Univ., Ann Arbor.
James C. T. Mayo, and David Knoll.
The Engineering Economist, Vol 12, No 4, p 229-239, Summer 1967. 2 fig, 8 ref, 1 append.

Descriptors: *Computers, Costs, Investment, Computer programs.

Identifiers: *Investment returns, *Internal rate of return, Rate of return, Multiple rates, Pure investment, Mixed investment.

In the theory of financial management, the internal rate of return is frequently regarded as the true rate of return. This is because the rate is supposed to be independent of the firm's cost of capital, and, therefore, internal to the investment. However, as Teichroew, Robicheck, and Montalbano point out, this assumption of independence does not hold for all investments. If the cash expenditures of an investment are not restricted to the initial period, the investment return may vary directly with the firm's cost of capital. Moreover, these subsequent outlays may cause the project to have multiple internal rate of returns. Teichroew, Robicheck, and Montalbano have provided the theoretical concepts for understanding investments with multiple internal rate of returns and for calculating the functional relationship between project return and cost of captial for such investments. This paper presents a computer program of implementing Teichroew's, Robicheck's, and Montalbano's theoretical analysis and to illustrate the usefulness of the program with meaningful examples. This article has relevance to water investment and rate of return problems. (Loeb-Rutgers)
W70-08708

MODELING AND PREDICTING HUMAN RESPONSE TO THE VISUAL RECREATION ENVIRONMENT,
Northwestern Univ., Evanston, Ill., and Corps of Engineers, Washington, D.C.
George L. Peterson, and Edward S. Neumann.
Journal of Leisure Research, Vol 1, No 3, p 219-237, Summer 1969. 5 fig, 4 tab, 5 ref.

Descriptors: *Forecasting, *Preferences, Swimming, Model studies, Statistical methods, Lake Michigan, Photography, Beaches, Recreation, Recreation facilities, Psychological aspects, Estimating.
Identifiers: *Modeling, *Human response, Natural beaches, Crowding, City swimming beaches, Subjective responses, Recreation environment, Factor analysis.

The purpose of this paper is to develop and apply a conceptual and methodological approach for analyzing subjective response to the appearance of the recreation environment. The conceptual framework employs a mathematical preference model to hypothesize and quantify a man-environment relationship. To obtain data for the model, recreation environments were sumulated by photos and responses classified by techniques of psychological measurement. The preference functions should be sensitive to differences in characteristics of alternative environments as well as to differences in people's responses to the same environmental conditions. It is hypothesized that such responses are influenced by measurable factors such as life style, social rank, culture rank, culture, and personality. The model is demonstrated using Lake Michigan beaches. Results show that two groups with different preferences are identifiable. The larger group prefers scenic natural beaches and the smaller prefers city swimming beaches. The study shows conflicting user preferences for the characteristics of beaches. Studies of this nature would be helpful to the water planner in determining the types of recreation facilities that should be provided. (Loeb-Rutgers)
W70-08709

THE ANALYSIS AND EVALUATION OF PUBLIC EXPENDITURES: THE PPB SYSTEM, A COMPENDIUM OF PAPERS SUBMITTED TO THE SUBCOMMITTEE ON ECONOMY IN GOVERNMENT OF THE JOINT ECONOMIC COMMITTEE.
Joint Committee on Economics (U.S. Congress). Subcommittee on Economy in Government.
Available from the Superintendent of Documents, Wash. D.C.: Vol 1, $2.75, Vol 2, $0.75, Vol 3, $1.75. Economic Joint Committee, Joint Committee Print, US Government Printing Office, Washington, DC, 1969. 124 p, 3 vols.

Descriptors: *Planning, *Budgets, *Economic evaluation, *Forecasting, Government, Resource allocation, Prices, Costs, Benefits, Economic efficiency, Decision-making, Water pollution optimization, Risk, Uncertainty, Data collection, Regional analysis.
Identifiers: *Programing, Budgeting, Institutional factors, Multiple objectives, Agency experience, Social overhead.

This is a three volume report on the use of the Planning, Programming and Budgeting (PPB) System in the analysis and evaluation of government expenditures. The study is divided into six parts. Part I considers the issues of economics and equity pertinent to governmental market decisions. The papers in Part II attempt to isolate the factors effecting governmental efficiency in expenditures. In Part III a few of the key problems in applying economic analysis in the public sector are discussed. Part IV is a comprehensive discussion of the PPB System in the Federal Bovernment. The papers in Part V appraise and evaluate the structure and performance of PPB to date. Those in Part VI direct attention to the major issues for policy analysis in each of the primary functional areas of the Federal budget. The large role played by government in the water resources area makes the PPB System described of use in the analysis and evaluation of government water resources investments. (Murphy-Rutgers)
W70-08721

SYSTEMS FOR ANALYSIS: PPB AND ITS ALTERNATIVES,
Brookings Institution, Washington, D.C.
Allen Schick.
In The Analysis and Evaluation of Public Expenditures: The PPB System, a compendium of papers submitted to the Subcommittee on Economy in Government of the Joint Economic Committee, US Government Printing Office, Washington, DC, 1969, Vol III, p 817-834.

Descriptors: *Systems analysis, *Economic evaluation, *Government, *Budgeting, *Planning, Programing, Management, Economic efficiency, Social aspects, Costs, Benefits, Decision-making, Time.
Identifiers: *PPB System, Program effectiveness, Public benefits, Crosswalk system, Two-track system, Policy planning.

The author examines the strength and weakness of the conception of the Planning-Programing-Budgeting (PPB) system relative to alternative approaches to public expenditures analysis. This topic represents an important method of evaluating public water resources investments. The paper considers several difficulties relating to the purpose and scope of policy analysis: (1) The budget process is evaluated as being nonanalytic or antianalytic, (2) Is a systems approach the most effective way to enhance the analytic caliber of public choices. The author feels it may be efficacious to promote analysis without regard for its systems character, (3) Assuming a system approach is justified, the author tries to determine what the mission and scope should be, (4) Finally the author then investigates whether the scope and focus of the analysis should be public benefits or program effectiveness. (Murphy-Rutgers)
W70-08722

TODAY'S PPBS: THE FATAL TRIUMPH OF FINANCIAL MANAGEMENT OVER ECONOMICS,
Veterans Administration, Washington, D.C.
Samuel M. Greenhouse.
In the Analysis and Evaluation of Public Expenditures: The PPB System, a Compendium of papers submitted to the Subcommittee on Economy in Government of the Joint Economic Committee, US Government Printing Office, Washington DC, 1969, Vol III p 886-898.

Descriptors: *Systems analysis, *Economic evaluation, *Planning, *Programming, *Budgeting, *Government, Forecasting Economic analysis, Decision-making, Management, Costs, Benefits, Value, Prices, Economic efficiency.
Identifiers: *PPBS, Marginal utility, Market system, Executive branch, Opportunity cost.

The emergence of the government as an economic enterprise calls for the development of procedures for the economic evaluation of government enterprise activities. In the area of water resources the government is often the largest investor so that a proper method of evaluation should be of interest to the water researcher. The author shows that an economic form of planning-programming-budgeting system (PPBS) is the procedure needed to replace the financial management type of PPBS presently in use. The marginal utility theory of value, because it provides the government with a conceptual basis upon which to appraise the benefit of an enterprise's individual offerings, is essential to an economic PPBS. Applying this theory calls for identifying the Federal enterprise's final outputs and the customers who receive them. In the last section the paper recommends a specific design including a standardized government-wide program structure and substructure for the economic PPBS. (Murphy-Rutgers)
W70-08723

PUBLIC EXPENDITURE ANALYSIS AND THE INSTITUTIONS OF THE EXECUTIVE BRANCH,
Laird Systems, Los Angeles, Calif.
Fred S. Hoffman.
In The Analysis and Evaluation of Public Expenditures: the PPB System, a compendium of papers submitted to the Subcommittee on Economy In Government of the Joint Economic Committee, Vol, 3 p 925-942, U.S. Government Printing Office, 1969.

Descriptors: *Planning, *Budgeting, *Programing, *Government, *Decision-making, Benefit-cost analysis, Forecasting, Social aspects, Economic efficiency, Multiple-purpose projects, Resource allocation, Risk, Income, Data processing.
Identifiers: *PPB, Executive branch, *Five-year plan.

There are large impediments to sound and objective economic analysis of public water resource investments. This paper, analyzes; 1- the origins of systematic analysis in the Federal Government, 2- the appropriateness and value of this kind of analysis, and 3- the obstacles in the executive branch that are being faced in the introduction of the planning, programing, budgeting, (PPB) system. The author discusses the problems raised by multiobjective programs, the lack of sound theory and the political sensitivity of many programs. The paper concludes with a discussion of a number of suggestions designed to increase the effectiveness of benefit cost information in the decision process. The general discussion of budgeting problems makes this paper relevant to researchers interested in the problems of financing and budgeting water projects. (Murphy-Rutgers)
W70-08724

THE STATUS AND NEXT STEPS FOR PLANNING, PROGRAMING, AND BUDGETING,
Bureau of the Budget, Washington, D.C.
Jack W. Carlson.
In the Analysis and Evaluation of Public Expenditures: The PPB System, a compendium of papers submitted to the Subcommittee on Economy In Government of the Joint Economic Committee, Vol. II, U. S. Government Printing Office, 1969.

Descriptors: *Planning, *Budgeting, Decisionmaking, *Programing, *Government, Forecasting, Economic evaluation, Financing, Costs, Benefits, Economic efficiency, Data collection, Resource allocation, Social aspects.
Identifiers: *PPB, *Program structure, Education, Issue letters, Financial planning.

The purposes of the Planning--Programing-Budgeting system (PPBS) are to aid decision-makers in more effectively allocating limited public resources, to reduce the portion of the budget that is uncontrollable, to understand the actual impact of public programs, to assure the orderly presentation of relevant analysis for decision making, to identify programs that no longer serve national objectives, to integrate long-range objectives with current-year budgets and to connect planning and budgeting with actual performance. These are vital aims in the evaluation of public water resource projects, making this paper of interest to the water researcher. The author argues that PPB has been moderately successful and will contribute a great deal to public policy decisionmaking in the future. In a set of thirteen attachments to the paper, a number of displays pertinent to the structure and functioning of the PPB System are presented. (Murphy-Rutgers)
W70-08725

THE PLANNING, PROGRAMING, AND BUDGETING SYSTEM IN THE DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE: SOME LESSONS FROM EXPERIENCE,
Brookings Institution, Washington, D.C.
Alice M. Rivlin.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, a compendium of papers submitted to The Subcommittee On Economy In Government of the Joint Economic Committee, Vol 3, p 909-922, U.S. Government Printing Office, 1969.

Descriptors: *Economic evaluation, *Planning, *Programing, *Budgeting, Decision-making, Systems analysis risk, Measurement, Statistics, Education, Project planning, Project purposes, Government.
Identifiers: *Health, Education, and Welfare, *PPB, Planning cycle, Five year plan.

Many of the problems involved in evaluating government programs in the area of health, education and welfare are similar to those encountered in water resources. Thus an insight into the evaluation of the former should be some help in studying budget problems for water projects. The author believes that systematic analysis and program evaluation are important components of an effective agency and efficient programs. The paper describes the evolution of systematic analysis in the Department of Health, Education, and Welfare, describing the program budget and information system, the quantitative evaluation of program accomplishment, the analysis of alternative policy actions and the development of a five year plan in the context of the planning cycle. This type of analysis is able to improve the decision-making process by largely reducing the element of uncertainty involved. The author concludes by stating the necessity of systematic analysis for effective planning and evaluation of government projects. (Murphy-Rutgers)
W70-08726

PRESCRIPTION FOR AN EFFECTIVE GOVERNMENT: ETHICS, ECONOMICS, AND PPBS,
Institute for Defense Analysis, Arlington, Va.
Paul Feldman.
In the Analysis and Evaluation of Public Expenditures: the PPB System, a compendium of papers submitted to the Subcommittee on Economy in Government of the Joint Economic Committee U S Government Printing Office, Washington, D.C., 1969, Vol III, p 865-885.

Descriptors: *System analysis, *Economic evaluation, *Budgeting, Decision-making, Planning, Forecasting, Economic justification, Government, Taxes, Cost, Benefits, Cost-benefit analysis, Financing, Competition.
Identifiers: *PPB, *Ethical criterion, *Market imperfections, Equilibrium.

This article indicates that since the inception of Planning-Program-Budgeting (PPB) there has been little modification in the substance of budget decision-making. PPB has been used to evaluate government water resource investments and this article should be relevant to the water researcher. The author discusses the reasons for the failure of PPB and points out the necessity of defining an ethical basis for government behavior without which PPB is useless. The paper then specifies an ethical code and draws conclusions regarding the desirable activities of government. A specific proposal is presented which applies these conclusions to the operation of the PPB system. The author finds that government should remove market imperfections and that when government undertakes expenditures it should attempt to distribute the tax burden in accord with the distribution of benefits. The new structure proposed for the PPB system indicates what standards should be used for measurement and in what direction the analysis should proceed. (Murphy-Rutgers)
W70-08727

ECONOMIC ANALYSIS IN NATURAL RESOURCE PROGRAMS,
George Washington Univ., Washington, D.C.
Jack C. Knetsch.
In: The Analysis and Evaluation of Public Expenditures: the PPB system, a compendium of papers submitted to the Subcommittee on Economy in Government of the Joint Economic Committee, U.S. Government Printing Office, Washington, D.C., Vol. III, p. 1087 to 1101.

Descriptors: *Economic analysis, *Cost-benefit analysis, *Natural resource development, *Government, Social aspects, Recreation, Pollution, Economic justification, Demand, Economic efficiency, Planning, Budgeting, Taxes, Forecasting.
Identifiers: *Market criteria, *Nonmarket values.

In this paper the author applies the concepts and techniques of benefit-cost analysis to additional public expenditure issues in natural resources programs. Although most public sector action in the natural resource field is a result of market failure, the author asserts that market criteria can be developed and applied to expenditure policy in this area. The author also appraises the demand studies done in the natural resource area and makes suggestions for improving procedures. He points out the problems related to those outputs of public projects which are difficult to quantify and measure and suggests some principles for improving the estimates of economic demands. The author then discusses the question of divergencies between social costs and benefits and those which fall on a single individual. He argues that the purely local or secondary benefits of public investment projects should not be counted in a national efficiency criterion. Although concerned with all natural resources, the authors comments are directly applicable to water resources. (Murphy-Rutgers)
W70-08728

THE USE OF DIGITAL SYSTEMS MODELING IN THE EVALUATION OF REGIONAL WATER QUALITY INVOLVING SINGLE OR MULTIPLE RELEASES,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 05B.
W70-08828

A BRANCH-AND-BOUND ALGORITHM FOR MULTI-LEVEL FIXED-CHARGE PROBLEMS,
Research Analysis Corp., McLean, Va.
Arnold P. Jones, and Richard M. Soland.
Management Science: Theory, Vol 16, No 1, p 67-76, September 1969. 1 fig, 2 tab, 9 ref.

Descriptors: *Optimization, *Mathematical models, *Linear programming.
Identifiers: Branch-and-bound algorithm.

Multi-level fixed-charge problems were mathematical optimization problems in which the separable portion of the objective function was the sum of piecewise continuous functions of a single variable. A description of a branch-and-bound algorithm that found a global solution to the problem was given. Several representative applications were described as examples. The algorithm had the feature that a good feasible solution was generated at the start. Moreover, at each step of the algorithm an additional feasible solution was generated for comparison with the best solution found previously. A linear mathematical function was used to illustrate the multi-level fixed-charge problem. Then the branch-bound algorithm using subsets where the solution value is less than or equal to the lower bound for every subject was described in order to find an optimal solution to the problem. Extensions of the work described was discussed. Numerous water resources problems contain fixed charge components, and techniques such as those described in this paper should be helpful in solving them. (Kriss-Cornell)
W70-08841

COMPUTER MODEL OF CONNECTICUT RIVER POLLUTION,
United Aircraft Corp., East Hartford, Conn. Research Labs.
For primary bibliographic entry see Field 05G.
W70-08843

EVALUATION OF ALTERNATIVE SOLUTIONS FOR ACHIEVEMENT OF RIVER STANDARDS,
Quirk, Lawler and Matusky, New York.
For primary bibliographic entry see Field 05G.
W70-08846

COMPUTER AIDS IN CRAG WATER PLAN,
Clark and Groff Engineers, Salem, Oreg.
Lloyd K. Clark, Andrew M. Klein, and Carter H. Harrison.
Water and Wastes Engineering, April 1970, Vol 7, No 4, p 49-51. 2 fig, 2 tab.

Descriptors: *Computer programs, *Digital computer, Design, Planning, Water Resources, Mathematical models, *Costs, *Optimization, Water demand.
Identifiers: Portland (Ore), Vancouver (Ore).

A computerized economic analysis was used to formulate a long-range regional water plan for the Portland-Vancouver area of Oregon and Washington. Each of four rivers in the four county area could supply twice the total demand anticipated by the year 2000 but the problem was to determine which of many sources might best serve each area. All regional planning in the Portland-Vancouver area was co-ordinated by the Columbia Region Association of Governments (CRAG). A long-range plan showing how the areas municipal water needs could be met up to the year 2000 with water demands expected to average almost 300 mgd and to peak at over 700 mgd was commissioned by CRAG. The demands will be met by potential sources that were listed. Future water requirements were based on future population density. A total of 90 water-use areas and 30 sources were developed and a digital computer was employed. The objective was to serve each water-use area at the lowest average cost. The computer approach consisted of four programs to increase efficiency. One program stored population and water-demand projections, another stored data on the sources of supply. The last two programs compared alternate ways of serving the water-use atea. Five major cost items were focused on : (1) transmission line construction; (2) treatment plant construction; (3) treatment plant

operation and maintenance; (4) source of supply costs; and (5) pumps and power. Advantages and disadvantages to the computer approach were given. (Kriss-Cornell)
W70-08847

FLOOD ROUTING USING A CONVECTIVE DIFFUSION MODEL,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-08848

RESISTANCE NETWORK FOR THREE-DIMENSIONAL UNCONFINED GROUNDWATER PROBLEMS WITH EXAMPLES OF DEEP WELL DEWATERING,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 04B.
W70-08849

ECONOMIC EVALUATION OF A WATER RESOURCES DEVELOPMENT PROJECT IN A DEVELOPING NATION,
California Univ., Berkeley.
Fereidoun Mobasheri.
Water Resources Center Contribution No 126, Hydraulic Engineering Laboratory. Univ. of Calif, Berkeley, July 1968. 191 p, 14 fig, 30 tab, 79 ref, 2 append.

Descriptors: *Optimization, *Linear programming, *Dynamic programming, *Cost-benefit analysis, *Social aspects, *Water resources development, *Economics, Synthesis, Multiple-purposes project, Irrigation water, Constraints.
Identifiers: Sensitivity analysis, Parameters.

An economic evaluation criterion was synthesized using the concept of benefit-cost analysis for estimating the social benefit and cost of a water resources development project in a developing country. The concept was modified so that multiple national goals and structural disequilibrium of the economy were considered. Shadow prices were used to measure economic value of production factors when there was a disequilibrium between demand and supply. The synthesized economic evaluation criterion was applied to a hypothetical multiple purpose water resources project. Using three design variables, a multi-level optimization technique was developed. The direct search technique combined with a parametric linear program and a dynamic program found the optimum combination of design variables to maximize the present net value of social benefit. The linear program found optimum allocation of annual supply of irrigation water among various crops to maximize the benefit from irrigation. The dynamic program determined optimum schedule of monthly releases from the reservoir to maximize return from power while mandatory releases, irrigation supply, and other physical constraints of the system were satisfied. A sensitivity analysis was carried out to determine optimum design changes as economic parameters were varied. (Kriss-Cornell)
W70-08854

ECONOMIC EVALUATION OF A WATER RESOURCES DEVELOPMENT PROGRAM IN A DEVELOPING NATION - CHAPTER V - MODIFICATION OF BENEFIT-COST ANALYSIS, SYNTHESIS OF A NEW CRITERION,
California Univ., Berkeley.
Fereidoun Mobasheri.
In: Water Resources Center Contribution No 126, Hydraulic Engineering Laboratory, Univ of Calif, Berkeley, p 36-77, July 1968. 1 fig, 53 ref.

Descriptors: *Cost-benefit analysis, *Water resources development, *Social aspects, Mathematical model, Equations, Synthesis.
Identifiers: Economic parameters, Shadow prices, Balance of payments.

Necessary modifications of the benefit-cost criterion for a water resources development project in a developing country were studied. The concepts of the social rate of discount and social opportunity cost of capital were introduced. An economic model was developed for measuring these two economic parameters. The problem of under-employment of unskilled agricultural labor was studied. Equations were developed for calculation of the shadow price for unskilled labor. The problem of balance of payments was introduced and equations were developed to show the effect of the development of a water resources project on the balance of payments. These modifications were then combined and an economic evaluation criterion was synthesized. (Kriss-Cornell)
W70-08855

ECONOMIC EVALUATION OF A WATER RESOURCES DEVELOPMENT PROJECT IN A DEVELOPING NATION - CHAPTER VI - OPTIMUM DESIGN OF A MULTIPLE PURPOSE WATER RESOURCES PROJECT,
California Univ., Berkeley.
Fereidoun Mobasheri.
In: Water Resources Center Contribution No 126, Hydraulic Engineering Laboratory, Univ of Calif, Berkeley p 78-123, July 1968. 9 fig, 22 tab, 18 ref.

Descriptors: *Optimization, *Linear programming, *Dynamic programming, *Mathematical models, Cost-benefit analysis, Design, Multiple purpose projects.
Identifiers: *Direct search technique, Economic parameters.

A hypothetical water resources project was developed when the criterion function synthesized for economic evaluation was used for calculation of social benefit cost of the project. A mathematical model was developed for optimum design of the project. Three economic parameters - the annual rate of gross national project growth, the degree of underemployment of unskilled labor and shadow foreign exchange rate, were parametrically varied to find how optimum design was affected by economic parameters. The optimization algorithm used to determine efficient allocation of available resources required to maximize net return was linear programming. Dynamic programming determined optimum operation of the project. Direct search for the optimum scale of development was obtained through the linear and dynamic program's subroutines. A sensitivity analysis performed determined changes in the optimum design as economic parameters were allowed to vary. Seven optimum designs were determined for seven combinations of the three economic parameters. (Kriss-Cornell)
W70-08856

AN OPERATIONAL WATERSHED MODEL STEP 1-B: REGULATION OF WATER LEVELS IN THE KISSIMMEE RIVER BASIN,
Central and Southern Florida Flood Control District, West Palm Beach.
For primary bibliographic entry see Field 04D.
W70-08858

WATERSHED MODELING BY ELECTRONIC ANALOG COMPUTER,
Utah Water Research Lab., Logan.
J. Paul Riley, and Duane G. Chadwick.
Typescript, 1968. 27 p, 10 fig, 11 ref.

Descriptors: *Analog computers, *Simulation analysis, *Hydrologic data, Watersheds (Basins), River basins, *Mathematical models, Optimization, *Water supply, Utah.
Identifiers: Sevier River, Circle Valley.

Assessment of the downstream consequences resulting from changes at specific locations in a hydrologic system to increase water supply was studied at Utah State University using electronic analog simulation. First a general introduction to simulation and a description of a hydrologic model were given. Specifically, the approach to hydrologic simulation at Utah State University was to subdivide the river basin into relatively large but meaningful components, describe their operation and fundamental processes as functions of data ordinarily available, verify, and improve definition by using more and smaller control volumes and increments. An actual hydrologic unit was then simulated. Results were obtained by the simulation of a subbasin of the Sevier River drainage in central Utah. It is referred to as Circle Valley and contains approximately 93,000 acres of mountain watershed and agricultural land. A hydrologic flow diagram where each block represents a basic hydrologic process expressed in mathematical terms was presented. A computer model synthesized these relationships and an analog flow chart for the model was shown. Mean monthly outflow values for 1962 were computed and observed. Analog simulation of other watershed areas was also attempted. (Kriss-Cornell)
W70-08860

FEDERAL EVALUATION OF RESOURCE ALLOCATION INVESTMENTS: A CASE STUDY,
Cornell Univ., Ithaca, N.Y.
Robert J. Kalter.
Water Resources and Marine Sciences Center and Department of Agricultural Economics, Cornell University, Ithaca, New York, February 1970. Tech Report No 24, AE Res 313. 89 p, 20 tab, 1 append.

Descriptors: *Resource allocation, *Investment, *Optimization, *Research and development, *Economic efficiency, Project planning, *Evaluation, West Virginia.
Identifiers: Empirical testing, Task force, Data problems, Stonewall Jackson Reservoir.

The report presented the results of a research effort whose principal objective was to empirically test the procedures recommended for evaluation of public resource investments by a Special Task Force of the Water Resources Council. The main recommendations of that task force included a broadening of the traditional framework of project analysis beyond economic efficiency to include additional criteria of regional development, environmental enhancement, and well-being of people. Since the methodology outlined for implementation by the task force was not often fully developed or was, at times, inconsistent with theoretical principles, four criteria for project evaluation were presented. In addition, alternatives in plan formulation and a system of accounts necessary to display evaluation results were developed. Each major section included subsections on conceptual foundation for evaluation of the particular objective, methodology necessary and appropriate for such evaluation, data needs and possible data sources for empirical implementation, consideration of actual data sources and a summary of specific data problems, empirical testing of the methods proposed with realistic hypothetical data and appropriate display of findings. Tests were conducted on the proposed project of the U.S. Army Corps of Engineers on the West Fork River, West Virginia known as the Stonewall Jackson Reservoir. The project involved a concrete dam and reservoir at Brownsville, WV which was multipurpose in nature. (Kriss-Cornell)
W70-08861

FACILITIES DESIGN - A PROBLEM OF SYSTEMS ANALYSIS,
Cornell Univ., Ithaca, N.Y.; and Birmingham Univ. (England).
Bryon W. Saunders.
Typescript for International Conference on Production Research, University of Birmingham, Birmingham, England, April 6-10, 1970. 12 p, 9 ref.

Descriptors: *Optimization, *Systems analysis, *Resources, *Waste treatment, *Pollution abatement, *Population, *Decision making, *Facilities, *Design, Water costs.

The problem of how to measure the internal activities of the manufacturing system which must be correlated with the externalities in the larger total ecosystem in order to achieve the necessary optimization was presented. Examples of waste and pollution were given to indicate the magnitude of the problem. The two most directly related factors causing the problem were suggested to be overpopulation and inadequate and inappropriate decision criteria in the form of product cost minimization. Overpopulation, within certain areas and regions, creates facilities design conditions and increasing rates of use of basic resources. It has many interesting facets that need research as 'systems' problems in such areas as clean air, water, oxygen, land, recreation, etc. It was postulated that the population problem therefore is the underlying cause of all others. Secondly, it was suggested that industry is a significant contributor to the problems because of its decision criteria. An example was given of the pollution of a Norwegion Valley. Inadequate systems designs have developed and therefore better criteria, more efficient measures of effectiveness, and development of studies that will replace empiricism and intuition with known measurements that will allow optimization of the total ecosystem leading to an improved 'quality of life' for all must be established. (Kriss-Cornell)
W70-08862

MATHEMATICAL MODELING IN HYDROLOGY,
International Association of Scientific Hydrology, Gentbrugge (Belgium).
D. R. Dawdy, and G. P. Kalinin.
Bulletin of the International Association of Scientific Hydrology, Vol XV, No 1, March 1970, p 145-154. 10 p, 24 ref.

Descriptors: *Mathematical models, *Hydrology, *Computers, *Data processing, Simulation analysis, *Parametric hydrology, *Stochasic processes, Systems analysis, *Water resources development, Design.

The report was prepared on behalf of the committee on Mathematical Models in Hydrology of IASH. The successful development of branches of hydrology such as hydrologic forecasting, hydrological calculations, theory of water resources control and mathematical processing of observation data by use of application of physical and mathematical methods and use of computers was discussed. Topics included were: (a) scientific data processing; (b) solution of the equations of mathematical physics; (c) semi-empirical hydrologic simulation; (d) theory and practice of water resources control; and (e) the shortcomings of present methods to the development of theoretical and applied hydrology and methods of runoff control. The three working groups of the committee, which stressed applications of particular mathematical tools rather than the discipline in which a particular problem occurred, were then presented. They were (1) Parametic Hydrology concerning deterministic models; (2) Stochastic hydrology concerned with probabalistic models such as chain simulation models or gueueing models; and (3) Water Resources Systems concerned with decision theory in planning and design and applications of operations research to the water resources field. A general picture of what has been done and what yet remains to be done in the area of mathematical models in hydrology was given. (Kriss-Cornell)
W70-08863

SURFACE IRRIGATION USING KINEMATIC-WAVE METHOD,
Utah Water Research Lab., Logan.
Cheng-lung Chen.
ASCE Proceedings, Journal of the Irrigation and Drainage Division, Vol 96, No IR1, Paper 7134, p 39-46, March 1970. 2 fig, 8 ref.

Descriptors: *Mathematical models, *Surface-groundwater relationships, *Irrigation design, Drainage, Infiltration, Overland flow, Soil water movement, Groundwater movement, Irrigation practices, Irrigation ditches.
Identifiers: *Kinematic wave models.

In the kinematic-wave method, one-dimensional unsteady mathematical models for flow in surface irrigation consist of the equation of continuity for the surface flow, the simplified equation of motion, a uniform-flow formula for the surface flow, the simplified flow equation for the subsurface flow, the infiltration equation or an empirical formula, and appropriately prescribed initial and boundary conditions. The kinematic-wave method alone is valid only for supercritical flow. The complete model may be solved to yield a general solution that depends on the solution form of the cumulative depth of the subsurface flow at the head ditch. A particular solution for a constant infiltration rate reduced from the general solution is shown to be compatible with that obtained from the modified Lewis-Milne equation. (Knapp-USGS)
W70-08948

PRIME-ALBERTA'S BLUEPRINT FOR WATER DEVELOPMENT,
Department of Agriculture, Edmonton (Alberta). Water Resources Div.
For primary bibliographic entry see Field 06B.
W70-08994

ELKHART LAKE, WISCONSIN COMPREHENSIVE PLAN.
Wisconsin State Dept. of Local Affairs and Development, Madison. Bureau of Local and Regional Planning.

Available from the Clearinghouse as PB-189 006, $3.00 in paper copy, $0.65 in microfiche. Final report, ELVPC-70-3, Jan 1970, 188 p.

Descriptors: *Wisconsin, *City planning, Recreation, Water pollution, Land use, *Planning, Maps, Economics.
Identifiers: Elkhart Lake (Wisconsin).

Elkhart Lake is a small recreation and tourist-oriented cast central Wisconsin community. Although recreation activities have shown some growth during the summer months, very little other industry exists in the village and growth has been moderate for the past several decades. It is anticipated that this trend will continue. A vital concern of local officials and citizens is the protection and preservation of Elkhart Lake, the village's primary recreational and scenic resource. Although little progress has been made to date, village officials and local interest groups are attempting to halt pollution of the lake through provision of sanitary sewer facilities to lake-shore properties, and restrictions on use of the lake for recreational activities.
W70-09004

6B. Evaluation Process

CONSTRUCTION PLANNING OF THE UNDERGROUND POWERPLANT,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
F. J. Patterson, and I. C. Dirom.
Engineering Journal - Canada, Vol 52, No. 10, p. 125-130, Oct 1969. 6 p, 3 fig, 4 tab.

Descriptors: *Construction, *Planning, Underground structures, Tunnel construction, *Underground powerplants, Powerplants, Contracts, Foreign construction, Hydroelectric plants, Coordination, Excavation, Sequence, Concrete placing, Scheduling.
Identifiers: Portage Mountain Powerplant, Canada; Canada, Construction methods, Equipment installation.

Construction planning was a vital factor in ensuring generation of power on schedule at the Portage Mountain Development in Canada. Detailed planning of the underground powerplant, selection of construction contracts, and assumed critical and near critical construction sequences are described. Four tabulations are included showing main construction contracts, some of the more important interlocking dates between the main powerplant contract and other associated contracts, and planned as compared to actual excavation methods and excavation and concrete placement rates. (USBR)
W70-08687

WATER IN THE DESERTS,
Office of Water For Peace, Washington, D.C.
Dean F. Peterson.
Paper International Conference on Arid Lands in Changing World, Univ Ariz, Tucson, June, 1969. 28 p, 2 fig, 2 tab, 34 ref.

Descriptors: *Deserts, *Water supply, *Ecology, Rainfall, Water, Dams, Wells, Water resources, Streams, Springs, Aquifers, Groundwater, Water quality, Grazing, Agriculture, Irrigation, Economics, Canals, Pumping, Hydroelectric power, Waterlogged land, Salinity, Floods, Technology, Arid lands, Bibliographies.
Identifiers: Orographic precipitation.

Life in the desert, as elsewhere, needs water for existence. By definition, deserts are dry, but life does survive, and man has used desert areas for his purposes for millenia. Man's capability to use the desert is changed as he gains new technology and new sources of energy that make new water supplies available to him, but his impact on the ecology of the desert also is different. The sources of water in the desert and how these sources are being used are reviewed. Large, complex irrigation systems existed 5000 yr ago, but new technological capabilities exists, including hydroelectricity, large dams, large and efficient earth moving equipment, and improved agricultural practices. Using modern technology, much can be done to permit further use of the attractive desert environment; great care and forethought are required, lest use becomes exploitation and the ecological consequences outweigh the benefits. (USBR)
W70-08689

THE BRANDYWINE PLAN,
Pennsylvania Univ., Philadelphia.
John C Keene, and Ann Louise Strong.
Journal of the American Institute of Planners, Vol 36, No 1, p 50-58, January 1970. 2 fig, 1 photo.

Descriptors: *Water resources, Eminent domain, Easements, Regulation, Data Collections, Communication, Political aspects, Legal aspects, Economics, Value.
Identifiers: *Brandywine Plan, Urban development, Local institutions, Personality patterns, Objectives, Inducements, Restrictions.

The Brandywine Plan was concerned with a program for protecting water resources and guiding urban development as it would occur over the next fifty years in a rural watershed thirty miles west of Philadelphia. The authors describe the development of the plan and the opposition and rejection of it via the political system, local institutions, the legal system, economic aspects, the personality and value patterns of the watershed residents. In conclusion, the authors recommend that for a proposal such as this to be accepted the following factors must exist: (1) There must be sufficient time available to work out a program that is endorsed by a substantial number of residents. (2) Proponents must be willing and able to proceed with experiments on a small scale so that some of the novelty of the program can be dispelled. (3) Objectives of the program must be modest so as to allow more flexibility in working out a successful compromise of conflicting interests. (4) Positive inducements must be available to balance restrictions perceived by residents. (Loeb-Rutgers)
W70-08690

ENGINEERING ECONOMY IN THE UNITED STATES IN RETROSPECT--AN ANALYSIS,
Stevens Inst. of Tech., Hoboken, N. J.
A. Lesser.
Engineering Economist Vol 14, No 2, p 109-115, Winter 1969, 7 p, 18 ref.

Descriptors: *Economic analysis, *Engineering, *Economics, *Resource development, *Cost-benefit analysis, Mathematical studies, Risk, Marginal utility, Computers, Input-output analysis, Budgeting, Investment, Financing, Bonds, Mathematical studies.
Identifiers: *Engineering economy, *Actuariel mathematics, Business cycle, Welfare economics, Capital rationing.

This article traces and analyzes the evolution of the main streams of thought of engineering economy in the United States. Engineering economy is defined as a guide for the economic selection among technically feasible alternatives for the purpose of a rational allocation of scarce resources. The three separate (but sometimes tangential) streams of thought on this topic are classical engineering economy, benefit-cost analysis and economic analysis. The study of these seems to indicate that resource development should be closely related to engineering economy in the United States. This conclusion is reached after considering both the three main streams of development and such considerations as risk, uncertainty, utility theory, and mathematical or computer models. Due to the importance of water resources in natural resource development, water researchers will find this article of interest. (Murphy-Rutgers)
W70-08691

CRITERIA FOR PUBLIC INVESTMENT: A COMMENT.
Johns Hopkins Univ., Baltimore, Md.

Journal of Political Economy Vol 78, No 1, p 175-177, Jan/Feb. 1970.

Descriptors: *Discount rate, *Economic evaluation, *Cost-benefit analysis government, Time, Income, Economic efficiency, Social aspects, Decision-making, Mathematical studies.
Identifiers: *Private investment, *Government investment, *Social cost, Opportunity costs, Rate of time preference.

The author is concerned with the recent interest shown in using the rate of return on private investments for discounting purposes when evaluating the time streams of benefits and costs generated by public investments. The proper discount rate to use when evaluating water resource investments has created controversy and this clarification of issues should prove valuable to the water resource planner. The paper shows that: (1) The social opportunity cost of transferring funds from the private to the public sector is independent of the source of such fund, i. e. private consumption or private investment. (2) The proper investment criterion for public investment is that the present discounted value, using the rate of return on private investment as the discount factor, of benefits minus costs be non-negative. (Murphy-Rutgers)
W70-08695

ANALOGUE COMPUTING FOR PROJECT EVALUATION,
Imperial Chemical Industries Ltd., Ill.
David W. Gillings.
The Engineering Economist Vol 11, No 2, p 1-11, Winter 1966. 11 p, 1 tab, 4 fig.

Descriptors: *Economic evaluation, *Project planning, *Computers, Economics, Profits, Digital computers, Analog computers, Income, Competition, Prices, Interest rate, Costs, Demand, Investment.
Identifiers: *Project evaluation, *Rate of return, *Cash flow.

Methods of profitability estimation based on discounted cash flow principles are now well established and widely applied. If the full benefit of using comprehensive methods is to be derived, there must, however, be extensive calculation. These methods should explore all of the alternative technical proposals for meeting the specified aim of the project and all the alternative conditions of the market in which the project will have to be operated. This can easily be accomplished through the use of computers. The author describes the application of computers to these computations and gives an example of an industrial problem. Some of the advantages are pointed out and other possible lines of application described. The importance of project evaluation and economic forecasting in the water resource area make this article valuable. (Murphy-Rutgers)
W70-08696

PLANNING IN RURAL AREAS,
Cornell Univ., Ithaca, N.Y.
Alan J. Hahn.
Journal of the American Institute of Planners, Vol 36, No 1, p 44-49, January 1970.

Descriptors: *Planning, *Rural areas, Governments, Costs, Demand, Cities, Zoning, Leadership, Natural resources.
Identifiers: Economic development, Urban poverty, Rural opposition, Rural values, Industrial development, Rural activity patterns.

Planning in rural areas is becoming increasingly important. First, there is the rising national concern with economic development of depressed rural areas. Second, there is recognition that urban poverty and related problems are, at least in part, a consequence of conditions in rural areas. Finally, the outward movement of dissatisfied urbanities is extending beyond areas that can accurately be called suburban, and into countryside and jurisdictions that are rural. These trends result in demands on the planning profession for application of its methods and expertise to rural communities. Nevertheless, planning in rural areas is often unsuccessful. A major obstacle is the recalcitrance of rural citizens, leaders, and government. Their acceptance of planning as an appropriate local public activity is absent, or half-hearted at best. The purpose of this paper is to explore reasons for this and suggest some solutions. It draws heavily on the experience with a regional development educational project in the Central New York Region, a five-county area around Syracuse, New York. This article may prove helpful to the planner involved with water resources development in rural areas. (Loeb-Rutgers)
W70-08698

NATURAL RESOURCES AND RESEARCH ADMINISTRATION,
Economic Research Service, Washington, D.C.
George A. Pavelis.
Journal of Soil and Water Conservation, Vol 24, No 4, p 127-131, July-August 1969. 16 ref.

Descriptors: *Natural resources, Management, Planning, Environment, Decision making, Economics, Communication.
Identifiers: *Research administration, Research, Resource management, Objectives, Cooperation.

Natural resource professionals often ask how public research organizations can focus their talents and resources more precisely on the realities of solving practical management problems. They question why decades of continuing and publicly supported research in all areas of agricultural science at state universities and by the U S Department of Agriculture have not produced a body of knowledge and experience specific and versatile enough to solve most problems encountered. These questions encompass the larger matter of how research and planning are related elements in determining how our natural environment should be managed. The author concludes that important avenues of improvement lie in clearly defining the objectives sought in making management decisions or in setting up research studies, in developing analytical information tailored to these objectives, and in developing responsive research organizations. The catalyst for progress in all three directions are free communications and cooperation among conservation minded individuals, planning technicians, their research associates in universities and government agencies, and the research organizations themselves. (Loeb-Rutgers)
W70-08699

A METHOD TO ANALYZE THE EFFECTS OF FLUCTUATING RESERVOIR WATER LEVELS ON SHORELINE RECREATION USE,
Waterloo Univ. (Ontario).
Reiner Jaakson.
Water Resources Research Vol. 6, No. 2, p. 421-529.

Descriptors: *Reservoirs, *Recreation, *Floods, *Water level, Optimization, Economic justification, River basins, Planning, Dams, Water supply, Data collections, Mapping, Beaches, Beach erosion, Computers, Maximization.
Identifiers: Buffalo Pound Lake, Lake Diefenbaker, Backshore.

This paper presents a method whereby the optimum water level for a reservoir can be identified based on an analysis of recreation potential of the shoreline at different lake levels. The author feels that the recreation segment of many multipurpose projects forms one of the more active basic economic catalysts for regional growth and that this justifies the maintenance of constant or near constant levels during the recreation season. The three stages involved in the analysis were field data collection, mapping and quantification. The methodology allows economic comparisons of the value of maintaining constant lake levels with the value of maintaining flood storage levels. (Murphy-Rutgers)
W70-08700

THE CONVENTIONAL WISDOM IN WATER PHILOSOPHY,
University of Southern California, Los Angeles; and Arizona State Univ., Tempe.
John M. Bruner, and Martin T. Farris.
Water Resources Bulletin, Vol 5, No 4, p 43-48, December 1969. 5 ref.

Descriptors: *Water policy, Investment, Water utilization, Water management, Water supply, Demand, Prices, Water allocation, Economics.
Identifiers: *Conventional wisdom, *Water philosophy, Water projects, Water images.

The National Academy of Sciences recently warned against the commitment of substantial investment funds for water projects without careful consideration of scientific, engineering, economic, and social perspectives which, in their estimation, should qualify major water management decisions. There is little doubt that investments are being made and contracted for that do not auger well for economic development. The objective of this paper is to attempt a partial explanation of actual and potential inefficiencies in water management by describing and lending empirical support to the existence of a barrier to effective water management. This barrier can be termed 'conventional wisdom in water philosophy.' The contention here is that for a variety of reasons, a conventional wisdom regarding water has evolved, and that it has crystalized into a widely held philosophy toward water that has exceedingly important policy implications. In addition, it appears that the principal effect of this philosophy is to limit the range of choice in water policy proposals, and to introduce a predisposition toward certain types of proposals to the exclusion of others. (Loeb-Rutgers)
W70-08701

INPUT-OUTPUT TECHNIQUES FOR URBAN GOVERNMENT DECISIONS,
California Univ., Los Angeles.
Werner Z. Hirsh.
American Economic Review Vol. LVIII, No 2, p 162-170, May 1968.

Descriptors: *Regional analysis, *Input-output analysis, Local government, Planning economic evaluation, Forecasting, Model studies, Sewerage, Recreation, Water supply, Demand, Taxes, Cost-benefit analysis, Economies of scale.
Identifiers: *St. Louis, Missouri, *Production function, Labor, Industrial development, Fiscal health.

This paper attempts a consideration of local urban governments and presents an urban public services projection model and a regional planning model to evaluate alternative plans in terms of their net fiscal health results. Input-output techniques are employed in each model. This article is of interest to the water researcher not only for its discussion of water and sewerage services, but also for the theoretical insight it provides in the use of input-output techniques for regional planning purposes. The first model treats government as a productive agent and assumes the existence of a linear homogenious production function. The local government services are disaggregated, according to uniformity of demand into five sectors, one of which is the water and sewerage sector. Using St. Louis, Missouri as a case study, control totals for each sector were estimated, inputs allocated to the supplying industrial sector and output allocated to the service recipients. Another model is then presented which seeks to explain the implications of exogenous and local private sector forces for fiscal health of the government. In the first stage the impact of changes in final demand on output and income is estimated with the second stage estimating the revenue and expenditure implications. (Murphy-Rutgers)
W70-08704

VOTING AND SOCIAL CHOICE,
Princeton Univ., N.J.
Donald E. Campbell.
The American Economist, Vol 14, No 1, p 35-44, Spring 1970. 3 ref.

Descriptors: *Welfare, Preferences, Social values.
Identifiers: *Voting, *Social choice, Indifference, Arrow's conditions, Binary relation, Transitivity social welfare function, Individual values, Alternatives, Social orderings, Democratic requirements, Nondictatorship condition, Neutrality, Pareto optimality.

This paper examines the problem of social choice along the lines developed by Arrow. All configurations, or states of the economy, that can be compared in terms of preference and indifference by individuals are socially ordered. Then the question of whether or not to undertake a particular public project can be settled by using the social ordering to compare, in terms of social preference and indifference, the configurations that would accompany the two options. Ideally a society could use the social ordering to choose the best of all feasible configurations. Arrow's technique of requiring the social ordering to depend upon the indifference maps of the individual economic units and to satisfy certain conditions claimed to be generally accepted are used. This paper derives the existence of a class of social orderings, each member of which satisfies two fundamental democratic requirements as well as Arrow's conditions 1, 2, 4, and 5 and a weak version of his Condition 3. Only orderings in a slightly more general class satisfy all of the seven conditions. The use of social ordering criteria is made implicitly in the water area when deciding whether or not to undertake a particular public project. (Loeb-Rutgers)
W70-08710

THE CONSISTENCY AND EFFICIENCY OF GENERALIZED LEAST SQUARES IN SIMULTANEOUS EQUATION SYSTEM WITH AUTOCORRELATED ERRORS,
Bristol Univ. (England).
M. R. Wickens.
Econometrica, Vol 37, No 4, p 651-659, October 1969. 12 ref, 1 append.

Descriptors: Statistical methods, Economics.
Identifiers: *Consistency, *Efficiency, *Generalized least squares, *Simultaneous equations, *Autocorrelated errors, Autoregressive process, Two stage least squares, Three stage least squares, Estimators, Madansky type estimator.

Several existing single equation estimators, designed for the case where the structural disturbances are generated by a first order autoregressive process, are generalized for situations where the autoregressive process is of higher order than one. These generalized estimators are shown to be consistent, both when the parameters of the generating process are known and unknown, and their asymptotic relative efficiencies are compared. Three full information estimators are also examined. They are shown to be consistent with asymptotic efficiencies ranked like their single equation counterparts. Among the results derived are the consistency of 2SLS and 3SLS in this situation and the overall relative efficiencies of the 'Theil-Fisher' type estimators compared with the 2SLS-3SLS and 'Madansky' type estimators. This article is of general interest to water research projects employing simultaneous equation models of estimation. (Author)
W70-08711

BEHAVIOR TOWARDS RISK WITH MANY COMMODITIES,
Yale Univ., New Haven, Conn.
Joseph E. Stiglitz.
Econometrica, Vol 37, No 4, p 660-667, October 1969. 1 fig.

Descriptors: *Behavior, *Risks, Prices, Income, Economics, Social values.
Identifiers: *Commodities, *Indifference map, Consumer behavior, Risk neutral, Price ratios, Utility, Consumer behavior, Ordinal utility, Cardinal utility, Quadratic utility function, Risk aversion, Engel curves, Time preference, Income-consumption curves, Bernoulli utility function.

In the recent development of the theory of consumer bahavior, there have been two seemingly disjoint strands: the ordinal utility theory of consumer's choice with many commodities and the Von Neumann-Morgenstern cardinal utility theory of consumer behavior under uncertainty where individuals maximize their expected utility. It has not been sufficiently realized how intimately related these two theories are. The purpose of this paper is to show what restrictions on the indifference map (e.g., on the income-consumption curves) are implied by alternative assumptions about consumer behavior under uncertainty and, conversely, what restrictions on consumer behavior under uncertainty are implied by alternative assumptions about the indifference map. The importance of the results obtained in this paper is threefold: first, they suggest further reasons for avoiding particular parameterizations of attitudes towards risk. Second, they provide a way of ascertaining some information about an individual's attitudes towards risks by looking at Engel curves. Third, if the different commodities are interpreted as consumption in different periods, then the techniques developed here can be used to infer restrictions on consumer time preference from certain assumptions about saving behavior under uncertainty and vice-versa. This would prove useful in the water area when investigating demands for water supplies under conditions of risk and uncertainty. (Loeb-Rutgers)
W70-08712

ECONOMICS AND A NEW SOCIAL SCIENCE THRESHOLD,
Resources for the Future, Inc., Washington, D.C.
Edgar S. Dunn, Jr.
Southern Economic Journal, Vol 36, No 4, p 353-364, April 1970. 9 ref.

Descriptors: Economies, Resources, Diffusion.
Identifiers: *Social science, Developmental problems, Metaphors, Growth, Information, Stage theory, Social system learning, Evolution, Social learning.

The author contends that the major social problems of our era are developmental problems and these are exacerbated by the inbalance in our understanding and practice of the process of social learning as it applies to deterministic physical systems in contrast with nondeterministic creative social systems. This condition is further exacerbated by our adherence to several limited, if not unrealistic, metaphors of social change. A science paradigm is emerging that sees the classical experimental method and the classical science metaphor as demonstrating limited applicability to the more general task of problem solving associated with social system development. The emerging social learning metaphor is trying to make manifest a more general and inclusive process of evolutionary experimentation that is more nearly identifiable with the root process of social system problem solving. The author contends that if economies is to continue making contributions to the domain of economic and social development, it must apply itself to the task of improving our understanding and practice of the process of social system learning. This general reasoning could be extended to the economics of the water area as it relates to the social system. (Loeb-Rutgers)
W70-08713

AN ECONOMICALLY MEANINGFUL AND WORKABLE SYSTEM FOR CALCULATING FLOOD INSURANCE RATES,
Chicago Univ., Ill.
Howard Kunreuther, and John Sheaffer.
Water Resources Research Vol 6, No 2, p 659-667, April 1970.

Descriptors: *Flood plain insurance, *Risks, *Floods damage, Cost, River, Economic efficiency, Flood frequency, River basin, Management, Government supports, Social aspects, Statistics, Flood-proofing.
Identifiers: *Flood Insurance Act, *Insurance rates.

This paper focuses attention on the operating issues related to the establishment of flood insurance premiums for individual residential structures. The proposition presented is that rates on new as well as on existing houses can be determined quickly and economically on the basis of individual characteristics and conditions rather than on an average rate for a widely varying zone. An individual rating basis would not require a change in the dual system of premiums, acturial rates for new structures and subsidized rates for existing structures, provided for in the Flood Insurance Act of 1968. The customizing of individual rates will eliminate the adverse selection feature of the present method where damage is averaged over a region and may also expedite the extension of flood insurance coverage. (Murphy-Rutgers)
W70-08717

MULTIDIMENSIONAL RISK AND THE MODIGLIANI-MILLER HYPOTHESIS,
Robert W. Resek.
The Journal of Finance Vol. XXV No 1, p 47-51, March 1970.

Descriptors: *Capital, *Costs, Debt, Risk, Economic evaluation, Optimization, Interest rate, Investment, Forecasting, Efficiency, Taxes.
Identifiers: *Modigliani-Miller Hypothesis, *Dept equity ratio, *Leverage, Bonds, Stocks, Default.

What is known as the Modifliani-Miller hypothesis states that the average cost of capital to any firm is completely independent of its capital structure. This has obvious implications for firms in the water

resource area with large capital investment and a long paypback period. The paper considers this proposition and shows that, under the general circumstances hypothesized by its authors the proposition in not true. They consider the different ways of raising capital and, because of the possibility of default on bonds in a world with taxes find the cost of capital to a firm likely to be affected by its financial structure. The conclusions of this paper point out the necessity for the water resource utility to consider varying its financial structure to minimize capital costs. (Murphy-Rutgers)
W70-08718

THERMAL POLLUTION: THE EFFECT OF THE PROBLEM,
La Salle Coll., Philadelphia, Pa.
For primary bibliographic entry see Field 05C.
W70-08719

ENVIRONMENTAL PROBLEMS,
Rutgers - The State Univ., New Brunswick, N.J.
Betty Ray Wilson.
Philadelphia, J. B. Lippincott Co. 1968, 183 p.

Descriptors: *Thermal pollution, *Water quality, *Environmental effects, Air pollution, Data processing, Pesticides, Desalination, Government, Financing, Fish, Management, Herbicides, Costs, Insecticides, Rivers, Population, Radiation, Waste disposal, Wells, Transportation, Reservoir, D.D.T., Urban renewal, Model studies.
Identifiers: Environmental synergisms, Housing.

This book is the result of a conference at Rutgers University on April 24 to 26, 1967 and concerned with encouraging college faculties to stimulate students to enter into careers in the environmental area. The book represents a selection of problems currently important and representative of the entire field of environmental quality control. It discusses the nature of environmental health sciences, the dimensions, issues and determinants of urban development, the overall behavior of man in his society and the problem and effects of pesticides in the environment. Of particular interest for the water researcher are the chapters dealing with the economic, biological and physical problems involved in thermal pollution and its effect on the environment. The book concludes with two chapters on the problem of environmental synergisms. (Murphy-Rutgers)
W70-08720

WATER FOR THE YEAR 2000,
Lawrence Burgess.
American Water Works Association Journal, Vol 62, April 1970, p 211-214.

Descriptors: *Water resources development, *Natural resources, *Non-structural alternatives, *Planning, Water demand, Water supply, Legislation, Cities, Area development, Federal government, Multiple-purpose projects, Project purposes, Water policy, Politcal aspects, Regulation, Water quality control, Pollution abatement, Water pollution, Water Quality Act, Water Resources Planning Act, Costs, Environmental effects, Ecology, Population, Aesthetics.

Water resources were first developed in the United States by private interests seeking to promote small-scale enterprises. Later, the federal government began large-scale water resource development in such fields as flood control, reservoirs, channel improvement, irrigation, transportation and water power. Unfortunately, most such projects were carried out to alleviate particular water problems, and comprehensive planning for water resource development was frequently missing. The river basin approach did not effectively integrate agriculture, mining, forests and urban areas in the development. In planning for future needs, more comprehensive planning is imperative. Consideration must be given not only to meeting the greater demand for water but to relating water resource development to standards of environmental quality. Consideration must be given such aspects of the environment as aesthetics, pollution abatement, and the prevention of overcrowding. Technology must serve, not dictate future development. (Hubener-Florida)
W70-08798

ON THE CHOICE OF RISK LEVELS IN MANAGERIAL DECISION-MAKING,
Kent State Univ., Ohio.
B. L. Myers, and A. J. Melcher.
Management Science: Applic, Vol 16, No 6, p B-31-B-39, Oct 1969. 5 tab, 15 ref.

Descriptors: Risks, Management, Decision making, Planning, Costs, Variables.
Identifiers: Alpha and beta values, Errors.

The purpose of the study was to develop a set of factors which would enable on to answer questions regarding specific alpha and beta values, whether they should be large or small errors, and to what kinds of decisions are the errors related. The set of factors found useful in thinking through the difficulties encountered were: (1) number of alternatives, (2) planning horizon, (3) past success of decision-maker, and (4) cost-revenue consequences of an action. The difference between the expected costs of proposed projects and the expected costs associated with reducing error levels was highlighted since the difference has led to some confusion in establishing error levels. It was hypothesized that several variables may be used to generate the error levels. (Kriss-Cornell)
W70-08842

RATIONAL URBAN PLANNING: PROBLEMS AND PROSPECTS,
Darwin G. Stuart.
Urban Affairs Quarterly, Vol 5, No 2, p 151-182, Dec 1969. 1 fig, 32 ref.

Descriptors: *Planning, *Mathematical models, Budgeting, *Constraints, Economics, Resources, Programs, *Analytical techniques, *Decision-making.
Identifiers: Rational Urban Planning, Goals, Urban problems, Community objectives.

The efficiency of comprehensive rational planning as a strategy for dealing with complex urban problems was examined. Implications of six basic steps involved in this rational process, in terms of the practical problems and tasks involved, were discussed. First, community objectives were identified. Then existing government programs and policies were cited. The basic analytic framework and mathematical models were developed for inputs and outputs. Relative goal achievement was stratified according to effected economic activities, social groups and spatial locations. Weights were assigned to community objectives and finally preferred alternatives were identifiedsubject to budget constraints. Many difficulties and weaknesses were identified because ofthe enormous informational requirements of the method. As an alternative the Lindbom Strategy of 'successive limited comparison' or 'disjointed incrementalism' was presented as a behavioral method of governmental, policy-making. Objectives and policies are chosen at the same time. Finally, a third general model which represents a middle-range compromise between the other two was proposed as a program-policy trade-off model. Using the Model Cities Program as an example, it was recommended as a workable alternative to comprehensive rational planning. Has 31 references. (Kriss-Cornell)
W70-08844

HYDROLOGIC ENGINEERING TECHNIQUES FOR REGIONAL WATER RESOURCES PLANNING,
Corps of Engineers, Davis, Calif. Hydrologic Engineering Center.
Augustine J. Fredrich, and Edward F. Hawkins.
Water Resources Bulletin, Vol 6, No 2, p 249-260, March-April 1970. 4 fig, 12 ref.

Descriptors: *Hydrology, *Engineering, *Regional analysis, *Planning, *Computers, Reservoirs, Water resources development, Hydrographs, California, Northeast USA, Missouri, River Basin.

The Hydrologic Engineering Center has been involved in aiding in the development of some hydrologic techniques for use in regional planning studies. Most of the new techniques emphasize computational procedures developed specifically for use with electronic computers. Many studies have been recently completed or are in progress. Three such studies were dealt with in detail. First, the initial effort in regional analysis was the formulation of procedures for determining standard flood estimates for southern California coastal streams using generalized criteria. Techniques developed were readily adaptable to the computer and determined representative unit hydrographs, losses and standard project precipitation for any location in the study area. As a result of the recent drought in the Northeastern United States, a study was made to evaluate present and future water supply reservoirs in that region. The study consisted of computerized studies of the hypothetical operation of a large number of reservoirs as a system. They were on many different streams throughout the region and had varying constraints. A third example given was the development of a computer-aided screening procedure for use in evaluating several hundred potential reservoir sites for the Missouri River Basin Comprehensive Framework study. Physical, hydrologic and climatologic data in estimating reservoir storage requirements throughout the basin were used. From this study there seem to be many potential areas of application for new hydrologic engineering techniques for use in regional water resources planning. (Kriss-Cornell)
W70-08845

EVALUATION OF ALTERNATIVE SOLUTIONS FOR ACHIEVEMENT OF RIVER STANDARDS,
Quirk, Lawler and Matusky, New York.
For primary bibliographic entry see Field 05G.
W70-08846

ECONOMIC EVALUATION OF A WATER RESOURCES DEVELOPMENT PROJECT IN A DEVELOPING NATION,
California Univ., Berkeley.
For primary bibliographic entry see Field 06A.
W70-08854

ECONOMIC EVALUATION OF A WATER RESOURCES DEVELOPMENT PROGRAM IN A DEVELOPING NATION - CHAPTER V - MODIFICATION OF BENEFIT-COST ANALYSIS, SYNTHESIS OF A NEW CRITERION,
California Univ., Berkeley.
For primary bibliographic entry see Field 06A.
W70-08855

ECONOMIC EVALUATION OF A WATER RESOURCES DEVELOPMENT PROJECT IN A DEVELOPING NATION - CHAPTER VI - OPTIMUM DESIGN OF A MULTIPLE PURPOSE WATER RESOURCES PROJECT,
California Univ., Berkeley.
For primary bibliographic entry see Field 06A.
W70-08856

UTILITY MEASUREMENT IN PUBLIC HEALTH DECISION MAKING,
California Univ., Berkeley.
David H. Stimson.
Management Science: Applic, Vol 16, No 2, Oct 1969, p B-17-B-30. 14 p, 1 tab, 3 fig, 44 ref.

Descriptors: *Decision making, *Resource allocation, *Model studies.
Identifiers: Tasks, Objectives, Maximizing effectiveness.

The Churchman-Ackoff approximate measure of value method was used to measure the utilities of objectives of decision makers in a large public health agency. The utilities thus obtained formed part of a model of a resource allocation problem faced by the agency in its role as allocator of a federal grant. A comparison of the normative solution derived from the model with the solution already decided upon by the agency tended to support the hypothesis that the members of the agency chose among alternatives as if they were maximizing expected utility. The first task given to the subjects used in the experiment was the assigning of values to seven objects used in the model. The second task was to compare the assignment of numerical values to objectives implicit in the choices of the first task with the ratings of the objectives in the second task in order to get a unique set of values for the objectives. The third task was designed to obtain the efficiency of each alternative to achieve each objective. The criterion used for the selection of alternatives in the model was the maximization of effectiveness. (Kriss-Cornell)
W70-08859

FACILITIES DESIGN - A PROBLEM OF SYSTEMS ANALYSIS,
Cornell Univ., Ithaca, N.Y.; and Birmingham Univ. (England).
For primary bibliographic entry see Field 06A.
W70-08862

PRIME-ALBERTA'S BLUEPRINT FOR WATER DEVELOPMENT,
Department of Agriculture, Edmonton (Alberta). Water Resources Div.
Reginald E. Bailey.
In: Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association, Urbana, Illinois, p 227-234, 1969. 3 fig.

Descriptors: *Water resources development, *Inter-basin transfers, Water conveyance, Water transfer, Water management (Applied), Planning, Irrigation water, Domestic water, Municipal water, Industrial water, Water supply.
Identifiers: *Alberta (Canada).

The program of the Alberta Water Resources Division to guide the development of the province's water resources is described. The greatest requirements for water are in southern Alberta where irrigation, industrial, domestic and municipal demands are well established. The largest rivers, however, are in the north carrying their water to the Arctic Ocean away from the centers of population. About 89 percent of the total water flowing through Alberta is carried by these northward flowing rivers. The remaining 11 percent must serve 85 percent of the population. The solution to this problem of distribution is the diversion of northern waters southward where they are more urgently needed. Basin by basin, a transfer of northern waters to the south is planned. In many cases short gravity diversions are possible. In all cases only surplus water from storage reservoirs will be diverted, thus protecting downstream users dependent upon present supplies. (See also W70-08597)
W70-08994

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

NEW JERSEY WATER SUPPLY COMM'N V STATE WATER POLICY COMM'N (WATER RATES FOR SURFACE AND SUBSURFACE WATER SUPPLIES).

129 N J L 326, 29 A2d 617-620 (1943).

Descriptors: *New Jersey, *Water rates, *Subsurface waters, *Water supply, Legislation, Diversion, Cities, Regulation, Judicial decisions, Legal aspects, State governments, Administrative agencies, Rivers, Water management (Applied), Local governments, Water allocation (Policy), Eminent domain, Water utilization, Percolating water, Wells, Surface waters.

Defendant commission pursuant to statute passed two resolutions establishing: (1) a minimum rate to be charged for the diversion of surface water in excess of a statutory minimum; and (2) fixing a different rate for water diverted from subsurface, well or percolating water supplies. Plaintiffs, public bodies organized for the purpose of providing a public water supply, objected to the Commission's resolutions. It was contended that the rate exceeded that allowed by law. Plaintiffs also argued that the statute was unconstitutionally discriminatory in not providing a uniform rate for both the diversion of surface and subsurface waters. Upon consideration of the statute involved, the court held that the commission had fixed a rate in excess of that allowed by law for the diversion of waters. However, the statute was constitutional in that there was such a substantial difference between the respective conditions relating to surface and subsurface waters as would sustain a difference in rate for diversion from each. (Barnett-Florida)
W70-08666

THE RELEVANCE OF BENEFIT COST ANALYSIS FOR ECONOMIC DEVELOPMENT,
Rhode Island Univ., Kingston.
David W. Fischer.
Engineering Economist, Vol 15, No 2, p 63-80, Winter 1970. 18 p, 20 ref.

Descriptors: *Benefit-cost ratios, Economics, Project planning, Costs, Foreign countries, Bibliographies, United States, *Social values, Public works, Payments, Investment, Decision making, Projects, Theory.
Identifiers: *Benefit-cost analysis, *Economic growth, Incentives, Developing countries.

The Western World's benefit-cost analysis is assumed a viable concept for planning economic development. Such an analysis relies heavily upon a theoretical base bearing little relationship to the overall context of development decisionmaking. An effort is made to denote the factors distorting the theoretical results of benefit-cost analysis. The structure of the economy obviates the direct applicability of such models; the values inherent in the Western World's benefit-cost approach rest in the economic context where they were formulated, with hidden costs for underdeveloped economies. (USBR)
W70-08678

AN APPLICATION OF SPATIAL EQUILIBRIUM ANALYSIS TO WATER RESOURCE ALLOCATION,
Guelph Univ. (Ontario); and University of New England, Armidale (Australia).
For primary bibliographic entry see Field 06A.
W70-08693

COST-SHARING FOR FEDERAL WATER RESOURCE PROGRAMS WITH EMPHASIS ON FLOOD PROTECTION,
Central Connecticut State Coll., New Britain.
James C. Loughlin.
Water Resources Research Vol 6, No 2, p 366-382, April 1970.

Descriptors: *Cost-sharing, *Government, *Water resource development, Optimization, Economic efficiency, Project costs, Planning, Flood control, Federal government, Financing, Water law, Benefits, Cost-benefit analysis, Recreation, Drainage, Reservoirs, Economic justification.
Identifiers: *Equity, *Efficiency, *Cost distributions.

The purpose of this paper is to highlight the inefficiencies and inequities that can arise under existing cost-sharing provisions for federally assisted water resource programs. The author points out that differences in cost-sharing may cause (1) other than the least-cost alternative to be chosen; (2) the optimal scale may not be chosen; and (3) there may be less than optimal use of existing capacity. The equity problems of differing cost-sharing arrangements include: (1) DIFFERING PATTERNS OF REIMBURSABLE COST DISTRIBUTIONS FOR SIMILAR PROGRAMS, (2) the tilting of project costs toward nonreimbursable functions, and (3) the arbitrary nature of existing cost-sharing provisions. Case studies pertaining to flood control are presented to illustrate several of the above points. A uniform cost-sharing policy for flood protection is also proposed. (Murphy-Rutgers)
W70-08697

A WELL SUPPLY IS BEST FOR VICKSBURG,
Allen and Hoshall, Memphis, Tenn.
Lorin B. Allen.
The American City Vol LXXXV, No 5, p 125-129, May 1970.

Descriptors: *Costs, *Economic evaluation, *Water supply, *Rivers, *Well water, Transportation, Filtration, Water quality, Pollution, Hardness, Treatment cost, Benefits, Temperature, Aeration, Filtration, Lime, Reservoir, Instrumentation, Storage, Soil analysis.
Identifiers: *Vicksburg, Consistency, Automation.

This paper discussed the economic and hydrological factors involved in the choice between using a well or a river as the municipal water supply in the city of Vicksburg, Mississippi. The cost of the well water was found to be greater than that of the river. However, the quality of the well water was better and more consistent than that of the river and was less susceptable to the possibility of future pollution. In addition, the well water made for simpler plant control, thus cost-benefit analysis dictated that well water be used. The treatment process is described in detail with special attention given to the plant design and distribution system. (Murphy-Rutgers)
W70-08705

STRUCTURE OF PUBLICLY-OWNED WATER UTILITIES,
Fristoe Goddard Keig.
American Water Works Association Journal, Vol 62, Apr 1970, p 215-219.

Descriptors: *Public utilities, *Water works, *Municipal water, *Cities, Urbanization, Water rates, Water utilization, Local governments, State governments, Legislation, Use rates, Costs, Economics, Budgeting, Cost sharing, Water policy, Comparative costs, Financing, Administration, Taxes, Political aspects, Coordination, Supervisory control (Power).

The vast majority of water systems serving municipalities in the United States are publicly owned and regulated primarily by city councils. These councils must approve the budget, rate structure, and extension policies of the utility. Except as to extension policies outside city limits and the rates charged in those areas, very few states regulate municipally-owned water utilities. Some problems arise in attempting to operate the municipal water systems as business enterprises. There are problems of coordination and cooperation with other departments whose functions involve use of municipal water. Often the necessary cooperation is lacking. Secondly, a municipal water system may be used to subsidize other governmental functions, thus reducing the expansion capability of the system and affecting its ability to set fair rates. There are also problems with political influence in personnel policies, extension policies and rate determination. The foregoing problems are not as prevalent in independently owned or state-regulated utilities. (Hubener-Florida)
W70-08799

REVERSE OSMOSIS CAN CUT COST OF WATER TREATMENT,
Gulf General Atomic, Inc., San Diego, Calif.
For primary bibliographic entry see Field 05F.
W70-08851

ECONOMICS OF THERMAL DISCHARGES,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 05G.
W70-08852

WASTE WATER CHARGES IN GREAT BRITAIN,
West Hertfordshire Main Drainage Authority, Rickmansworth (England).
For primary bibliographic entry see Field 05D.
W70-08853

FEDERAL EVALUATION OF RESOURCE ALLOCATION INVESTMENTS: A CASE STUDY,
Cornell Univ., Ithaca, N.Y.
For primary bibliographic entry see Field 06A.
W70-08861

IS WATER DIFFERENT,
Department of Energy, Mines and Resources, Ottawa (Ontario). Policy and Planning Branch.
Frank Quinn.
In: Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association, Urbana, Illinois, p 243-246, 1969. 9 ref.

Descriptors: *Water distribution (Applied), *Water allocation (Policy), *Water law, *Administration, *Water policy, Water demand, Water utilization, Equitable apportionment, Legal aspects, Planning, Water rights, Water requirements.
Identifiers: *Water resources policy.

At one time, most of nature's resources were made readily available to users on the Western frontier, as part of a public policy which encouraged settlement and development. Today only water remains so free to its developers and, at the same time, so dependent on governmental regulation. The costs of manipulating this resource which appears and reappears through the range of competing human pursuits and natural balances, have indeed become more, rather than less, difficult to evaluate. Analogies may be expedient; but it appears at best premature, and at worst irresponsible, to suggest that water can be marketed as a commodity essentially no different from a bushel of wheat or a barrel of oil. (See also W70-08597)
W70-08997

6D. Water Demand

STRUCTURE OF PUBLICLY-OWNED WATER UTILITIES,
For primary bibliographic entry see Field 06C.
W70-08799

IS WATER DIFFERENT,
Department of Energy, Mines and Resources, Ottawa (Ontario). Policy and Planning Branch.
For primary bibliographic entry see Field 06C.
W70-08997

6E. Water Law and Institutions

CHESAPEAKE AND O RY V SALYER (ACTION FOR DAMAGES CAUSED BY PERMANENT STRUCTURE BARRED BY STATUTE OF LIMITATIONS).

272 Ky 171, 113 SW2d 1152-1158 (1938).

Descriptors: *Kentucky, *Flood damage, *Obstruction to flow, *Bridges, Judicial decisions, Legal aspects, Damages, Overflow, Floods, Streamflow, Flow, Streams, Backwater, Structural members, Piles (Foundations), Structures, Barriers, Dams, Structural design, Railroads, Legislation, Land tenure, Remedies.
Identifiers: *Statutes of limitation.

In an action for damages caused by overflow of water, plaintiffs alleged that defendant railroad company's bridge was so improperly constructed as to create an accumulation of drift and debris in a creek thereunder. This accumulation and the resultant obstruction to flow caused a water backup which inundated plaintiffs' lands. Defendant argued that plaintiffs' action was barred by a statute of limitation requiring suit to be brought within five years of the initial damage. The Court of Appeals of Kentucky stated that the statute operated as a bar only where a single recovery was required for all damages, past and future. The statute would not run where recurring recoveries for recurring damages were possible. Where a permanent structure is negligently constructed and cannot be reasonably repaired to avoid recurring injuries, there must be a single and not recurring recoveries. Plaintiffs had proceeded under the theory that the bridge was such a permanent structure incapable of repair. Since plaintiffs could obtain only a single recovery under such theory, this action was held barred by the statute of limitation. (Snow-Florida)
W70-08663

HOBAN V BUCKLIN (PRESCRIPTIVE RIGHTS TO LAKE SHORE).

184 A 362-369 (N H 1936).

Descriptors: *New Hampshire, *Lake shores, *Prescriptive rights, *Recreation, Lake beds, Lakes, Public rights, Boating, Swimming, Navigation, Navigable waters, Remedies, Legal aspects, Judicial decisions, Structures, Docks, Shores, Recreation facilities, Land use, Right-of-way, easements, Relative rights, Land tenure, Real property.
Identifiers: *Injunction (Temporary).

Plaintiff operated a boys camp during the summer season. Incident to the camp's operation, plaintiff used a lake and a portion of the abutting land thereto located on the opposite side of a highway from the camp. Plaintiff's grantor had constructed a wharf and boathouse over the lakebed, which plaintiff used in conjunction with swimming and boating. To that portion of the lakefront which was used in connection with his camp, plaintiff claimed a prescriptive right. Plaintiff contended that his non-occupancy during the periods when the camp was not open could not alone interrupt his continued possession. He did not voluntarily abandon such possession nor did defendant, who claimed title to the property, actually disturb plaintiff's exercise of his right-of-way. The court permitted plaintiff to tack the period of his grantor's adverse use of the lake and adjoining property onto his own holding periods, finding that plaintiff's rights had ripened into an easement by prescription. The court refused to enjoin any temporary trespass, as a legal remedy at law was available to defendant. (Finman-Florida)
W70-08669

THE BRANDYWINE PLAN,
Pennsylvania Univ., Philadelphia.
For primary bibliographic entry see Field 06B.
W70-08690

NATURAL RESOURCES AND RESEARCH ADMINISTRATION,
Economic Research Service, Washington, D.C.
For primary bibliographic entry see Field 06B.
W70-08699

WATER MANAGEMENT INNOVATIONS IN ENGLAND,
Michigan Univ., Ann Arbor.
Lyle E. Craine.
Washington, D.C. Resources For the Future, Inc., 1969. 123 p.

Descriptors: *Water management, *Water law, *Economic evaluation, Institutions, Government, Institutional constraints, Financing, History, Water supply, Demand, Water resource development, Conservation, Wastes, Population, Costs, Planning, Taxes, Economic efficiency, Flood control, Rivers, Income, Construction, Discharge.
Identifiers: *England, *Water Resources Act, River Authority, Licensing.

This study describes and evaluates the policy and institutional aspects of the British system of water management. The legal powers, the administrative structure and the provisions for the financing of water resources are described in historical context with the aim of determing if they provide an institutional setting favorable to water management. As a basis for the evaluation, the concept of water management is examined and elaborated. Its characteristics and the conditions necessary for its effective pursuit are identified and institutional criteria are proposed. The monograph was presented in the belief that the British experience may be instructive in the search for effective policies and institutions to deal with water use and development in the large urbanizing regions of the United States. (Murphy-Rutgers)
W70-08702

INPUT-OUTPUT TECHNIQUES FOR URBAN GOVERNMENT DECISIONS,
California Univ., Los Angeles.
For primary bibliographic entry see Field 06B.
W70-08704

DANFORTH V UNITED STATES (TAKING OF LAND FOR LEVEE CONSTRUCTION).

105 F2d 318-321 (8th Cir 1939).

Descriptors: *Missouri, *Mississippi River, *Levees, *Easements, Alluvium, Floods, Flood control, Flood protection, Embankments, Legislation, Judicial decisions, Legal aspects, Federal government, Land tenure, Mississippi River Basin, Historic flood, Floodways, Diversion structures, Damages, Diversion.

Appellant owned land a few miles inland from the Mississippi River. The federal government constructed levees on a part of appellant's land to aid in flood control. Appellant contended that this was a taking of his property within the provisions of the Mississippi River Flood Control Act of 1928. The Act provided for purchase of flowage rights for 'additional destructive flood waters that will pass by reason of diversions from the main channel of the Mississippi River.' The court, in holding for the United States, stated that the construction of a set-back levee did not constitute a taking of appellant's property. Further, the government acquired a flowage easement over appellant's lands for water that would be diverted there by the set-back levee. The levee would not divert any additional water from the main channel of the river and, therefore, appellant was not entitled to compensation under the Act. (Hubener-Florida)
W70-08748

LYNN V UNITED STATES (EMINENT DOMAIN: COMPENSATION FOR OBSTRUCTION OF LAND DRAINAGE CAUSED BY INCREASED BACKWATER LEVEL).
110 F2d 586-590 (5th Cir 1940).

Descriptors: *Drainage, *Subsurface drainage, *Backwater, *Eminent domain, Dams, Subsurface runoff, Tennessee, Tennessee River, Tennessee Valley Authority Project, Federal government,

Flooding, Project planning, Surface drainage, Drainage waters, Watersheds (Basins), Surface runoff, Relative rights, Judicial decisions, Drainage systems, Compensation, Obstruction to flow, Riddance (Legal aspects), Repulsion (Legal aspects), Easements, Water level fluctuations.

In an action to recover the value of easements, plaintiff contended that the United States had, by raising the level of the backwater of a Tennessee Valley Authority dam, obstructed the drainage of his land. The land was drained by a system of natural underground caves, by underground drains, and by surface drainage. The obstruction caused surface water to be impounded so as to permanently damage his property. Plaintiff contended that he had an implied easement to discharge his drains through lands previously deeded by him to the United States and that obstruction to drainage amounted to the taking of property, the easement, without compensation. The court held that plaintiff did have an easement and that such was property which could not be taken without compensation. However, the United States, in exercising its power over navigable streams, may raise the level thereof and thereby obstruct the drainage of surface waters on nearby lands. Even though damages occur, the land is not taken, in the constitutional sense, unless the waters of the river are backed upon the land. The damages caused by the obstruction to the drainage was not a taking of property, and plaintiff was not entitled to compensation. (Snow-Florida)
W70-08749

UNITED STATES V BAILEY (REAL PROPERTY VALUATION IN CONDEMNATION PROCEEDINGS FOR TENNESSEE VALLEY AUTHORITY PROJECT).
115 F2d 433-434 (5th Cir 1940).

Descriptors: *Tennessee Valley Authority Project, *Condemnation, *Property values, *Land appraisal, Federal government, Judicial decisions, Adjudication procedure, Legal aspects, Eminent domain, Condemnation, Governments, Value, Compensation, United States, Crop production, Evaluation, Real property, Land use, Forests, Land, Cultivated lands, Irrigable land, Arable land.

Plaintiff United States government proceeded against defendant landowner to condemn land for use by the Tennessee Valley Authority. The sole issue was the value of three tracts of land, which were a mixture of creek bottom land, timber land, open hillside and minimal improvements or cultivation. Although defendant contended that the land was suitable for cultivation, his failure to cultivate it for 38 years supported plaintiff's evidence that the best use of the land was for growing timber. Lacking evidence of similar sales involving willing buyers and sellers, the court held that evidence of prices paid by plaintiff in similar nearby condemnation proceedings was inadmissable. The award made by the commissioners appointed by the district court was affirmed. (Liptak-Florida)
W70-08750

UNITED STATES V WEST VIRGINIA POWER CO (LEGALITY OF MULTIPLE PURPOSE PROJECT CONSTRUCTED PURSUANT TO EXECUTIVE ORDER).
122 F2d 733-739 (4th Cir 1941).

Descriptors: *West Virginia, *Eminent domain, *Federal project policy, *Condemnation, Flood control, Reservoirs, Dams, Water conservation, Channel improvement, Navigation, Federal government, Watershed management, Judicial decisions, Legal aspects, River regulation, Watercourses (Legal), Legislation, Compensation, Electric power production, Standards, Projects.

Petitioner United States brought action against the West Virginia Power Company to condemn land for the erection of a flood control, power and navigation dam and reservoir. Defendants contended that the executive order to construct the project was void, as the project had neither been authorized by Congress nor had it met the recommendations of the Chief of Engineers of the Army. Defendants further contended that the project was unconstitutional since it was a multiple purpose project. The court held that the executive order authorizing the project was not bound by the conditions within the recommendations of the Chief of Engineers, and consequently the order was valid. Furthermore, in subsequent legislation the project had been approved by Congress. The project was, therefore, within the requirements of the National Industrial Recovery Act. The project was held not to be affected by certain requirements pertaining to state-federal cooperation as it had been specifically exempted by Congress. In addition, the court held that it is for Congress to determine what type of project will best serve the constitutional purpose it is pursuing. The judgment for defendants was reversed, and the lower court ordered to pass on the government's motion for immediate possession. (Price-Florida)
W70-08751

UNITED STATES V TILLEY (THE RIGHT TO SEEPAGE AND THE ASSIGNMENT OF APPROPRIATIVE RIGHTS).
124 F2d 850-864 (8th Cir 1941).

Descriptors: *Nebraska, *Appropriation, *Federal-state water rights conflicts, *Seepage, United States, Federal government, Judicial decisions, Legal aspects, Legislation, Natural flow doctrine, Preferences (Water rights), Prior appropriation, Public rights, Relative rights, State governments, Federal jurisdiction, Unappropriated waters, Watercourses (Legal), Irrigation, Irrigation systems, Irrigation programs, Return flow, Water reuse, Reclamation, Contracts.
Identifiers: *Public waters.

Two issues involving federal-state water rights conflicts were raised by this case: (1) whether defendant engineer for the state of Nebraska had transfered to plaintiff United States its appropriative rights to the natural flow waters of the North Platte River; and (2) whether defendant had the right to interfere with plaintiff's collection of seepage waters from irrigation lands located in plaintiff's North Platte Irrigation Project. Plaintiff and defendant had entered into a contract wherein plaintiff had agreed to release from its stored sources into the North Platte River an amount of water which, added to the water defendant would be entitled to be appropriation, would aggregate 180,000 acre feet per year. Delivery of such water would be accepted as full satisfaction of all of defendant's right to water of the North Platte River. The court held that since the contract did not expressly assign defendant's appropriative rights to plaintiff, the contract did not transfer such rights to plaintiff. As to the second issue, the court held that Nebraska law allowed an appropriator of public waters for use in an irrigation project to collect seepage waters upon any land under such project and to re-use them. The United States, as any other appropriator, was protected by this law. (Clarke-Florida)
W70-08752

UNITED STATES V ELLIOTT (OWNERSHIP OF BEDS OF NON-NAVIGABLE WATERS).

131 F2d 720-724 (10th Cir 1942).

Descriptors: *United States, *Boundary disputes, *Ownership of beds, *Riparian rights, Boundaries (Property), Contracts, Federal government, Federal jurisdiction, Judicial decisions, Land tenure, Legal aspects, Legislation, Proprietary power, Public rights, Relative rights, Reservation doctrine, Riparian land, Riparian waters, Usufructuary right, Non-navigable waters, Islands, Rivers.

In 1832 defendant United States granted to the Seneca Nation a tract of land whose boundary on the east was described as 'all land on the west side of the Grand River, a non-navigable stream.' Plaintiff acquired from the Senecas title to an island entirely located west of the midline of the river. Defendant claimed that such title was invalid because the land granted to the Senecas extended only as far as the west bank of the river. The court held that a grant of land bounded on a non-navigable stream carries the exclusive right and title of the grantee to the center of the stream unless the terms of the grant clearly denote the intention to stop at the edge of the stream. The language of the treaty did not indicate such an intent. Consequently, plaintiff's title to the island was upheld. (Clarke-Florida)
W70-08753

UNITED STATES V COMMODORE PARK, INC (RIGHT OF THE UNITED STATES TO TAKE PROPERTY FOR THE IMPROVEMENT OF NAVIGATION).
324 US 386, 65 S Ct 803-806 (1945).

Descriptors: *United States, *Virginia, *Riparian land, *Riparian rights, Federal government, Streams, Alteration of flow, Dredging, Navigation, Eminent domain, Landfills, Real property, Judicial decisions, Legal aspects, Dams, Shores, Planning, Non-structural alternatives, Regulation, Compensation, Fishing, Tidal waters, High water mark, Low water mark, Navigable waters.

Defendant United States conducted a dredging operation in a tidewater navigable bay and deposited the dredged matter in a navigable arm of the bay, thereby destroying its navigability. Plaintiff, who owned property along the arm, brought action for damages resulting from the 'taking' of his riparian right of access to the navigable waters. Defendant's answer alleged that plaintiff's riparian right of access to the navigable waters was subordinate to the government's plenary authority over navigable waters of the United States in aid of navigation or commerce. The district court held the entire project had no substantial relation to navigation or commerce and awarded damages for plaintiff. The Circuit Court of Appeals affirmed, but the United States Supreme Court reversed, stating that the dredging was done in aid of navigation and that the United States does have the power to control and regulate navigable waters in the interest of navigation and commerce without payment of compensation. As against the demands of commerce, riparian landowners whose lands are invaded have no right for compensation for the loss of access to navigable waters even though such loss may cause a decrease in the value of their property. (Barnett-Florida)
W70-08754

STEWARD V UNITED STATES (TITLE TO SWAMP LAND ADJACENT TO GOVERNMENT HOLDINGS).
316 US 354, 62 S Ct 1154-1159 (1942).

Descriptors: *United States, *Islands, *Tidal marshes, *Boundary disputes, Land tenure, Boundaries (Property), Bays, Marshes, Swamps, Bodies of water, Coastal marshes, California, Governments, Legislation, Federal government, Public lands, Relative rights, Judicial decisions, Legal aspects, Military aspects, Beds under water, Surveys, Mapping, Real property.
Identifiers: *Swamp Lands Act of 1850.

The United States sought to quiet title to an area of tule marsh adjacent to an island owned by the government in a bay. The government had purchased title to the island and claimed that the land in question was part of the purchase because it was joined to the island by a narrow neck. Defendants claimed title to the swamp under the Swamp Lands Act of 1850 and argued that it was not part of the original grant under which the government claimed title to the island. Defendant claimed that the connecting neck was often under water at high tide, and therefore the government's claim could not extend to land beyond the high water mark. The U. S. Supreme Court, accepting the findings of

fact of the trial court, found that the government's claim ran only to the high water mark and thus did not extend to the area separated by high tide from the island. The Circuit Court decision for the government was reversed. (Barker-Florida)
W70-08755

UNITED STATES V CHICAGO, M, ST P AND P RR (FEDERAL COMPENSATION FOR CONDEMNATION OF FLOODED LANDS BELOW HIGH WATER MARK: IMPROVEMENT OF NAVIGATION).

312 US 592, 313 US 543, 61 S Ct 772-776 (1941).

Descriptors: *United States, *Condemnation, *Navigable rivers, *Compensation, Eminent domain, Mississippi River, Right-of-way, Riparian rights, Riprap, Bank protection, Embankments, Shore protection, Navigable waters, Navigation, Railroads, Water levels, High water mark, Low water mark, Easements, Relative rights, Ownership of beds, Judicial decisions, Legal aspects, Flooding, Federal government.

Plaintiff United States brought a condemnation action to acquire the right to flood a right-of-way and embankment owned by defendant railroad companies. Plaintiff claimed the right through its power over commerce and navigability of rivers. Defendants operated a railroad track and telegraph line on the west bank of the Mississippi River, and part of their right-of-way lay between the high and low water marks. Defendants claimed ownership to the low water mark and argued that the government must compensate them if the water level was raised through a plan to improve the navigability of the river. The government claimed the right to raise the water level to the ordinary high water mark without compensation to riparian owners. The U. S. Supreme Court held that the government's interest in navigation included all the lands below the high water mark and that exercise of power within those limits was not an interference with private property rights. No compensation was awarded. (Barker-Florida)
W70-08756

UNITED STATES V APPALACHIAN ELECTRIC POWER CO (DAM CONSTRUCTION: INTERFERENCE WITH NAVIGATION AND COMMERCE).
311 US 377, 61 S Ct 291-312 (1940).

Descriptors: *United States, *Navigable rivers, *Hydroelectric project licensing, *Dam construction, Interstate, Governments, Administrative agencies, State governments, Interstate rivers, Surface waters, Electric power, Legislation, Legal aspects, Political aspects, Navigation, Damsites, Virginia, West Virginia, Hydroelectric plants, Judicial decisions, Multiple-purpose projects, Dams, Supervisory control (Power), Navigable waters, Eminent domain.

The United States sought to enjoin the construction of a dam and an electric power plant on a river which flowed through Virginia and West Virginia. The United States claimed the construction was proceeding without the grant of a license for such by the Federal Power Commission pursuant to control by the federal government over navigable rivers and interstate commerce. Defendant electric power company argued that the river was not navigable and thus no license was required. Defendant further argued that even if the river were navigable and the license were necessary, the provisions of the license as offered were illegal and unconstitutional in that they usurped state regulation and amounted to an uncompensated taking. The United States Supreme Court found that the river was navigable and that the provisions of the license were wholly within the bounds of congressional control over navigation and interstate commerce. The lower court decisions in favor of defendant were reversed. (Barker-Florida)
W70-08757

CHESEBRO V LOS ANGELES COUNTY FLOOD CONTROL DIST (ASSESSMENTS OF LANDS BY DRAINAGE DISTRICTS).
306 US 459 S Ct 622-625 (1939).

Descriptors: *United States, *Drainage districts, *Assessments, *Costs, Judicial decisions, Legal aspects, Administrative agencies, Flood control, Operation and Maintenance, Regulation, Benefits, Drainage systems, Financing, Taxes, Legislation, California, Cost allocation.

Plaintiff owned taxable real property within defendant flood control district but outside certain drainage districts that were transferred to defendant pursuant to statute. Plaintiff contended that the statute, which authorized the administrative board of the district to levy special assessments on his land within the flood control district for the purpose of paying the debts and obligations of other special assessment districts without regard to the accrual of benefits to the lands assessed, would deprive him of his property without due process of law in violation of the 14th amendment. From a denial by the Supreme Court of California to restrain this assessment on his land, plaintiff appealed to the Supreme Court of the United States. In affirming, the Supreme Court held that in the absence of flagrant abuse or purely arbitrary action, a state may establish local districts to include lands that it finds will be specially benefited by drainage, flood control or other such improvements. Furthermore, to acquire, construct, maintain and operate such burdens on those lands deemed benefited. (Barnett-Florida)
W70-08758

IN RE COUNTY DITCH NO 50, FARIBAULT COUNTY (PARTIES DIRECTLY AND INDIRECTLY AFFECTED BY LATERAL DRAIN AND DITCH IMPROVEMENT PROCEEDINGS).
177 NW2d 54-56 (Minn 1970).

Descriptors: *Minnesota, *Laterals, *Ditches, *Adjudication procedure, Drains, Drainage, Administrative agencies, Administrative decisions, Tile drainage, Tile drains, Tiles, Surface drainage, Surface runoff, Surface waters, Local governments, Judicial decisions, Runoff, Outlets, Outlet works, Drainage effects, Water control, Legal aspects, Riddance (Legal aspects), Land tenure, Remedies.
Identifiers: *Improvements (Drainage).

Plaintiff landowners appealed from an order of defendant county commission approving construction of a lateral drain which sould empty into an existing county ditch. Plaintiffs contended that the existing ditch, which adjoined their property, was inadequate to handle the increased flow of water from the proposed lateral drain, thereby requiring that they be given statutory notice of improvement proceedings and an opportunity to intervene. Defendant contended that plaintiffs were only indirectly affected and that only those who lived alongside the proposed lateral drain were proper parties to improvement proceedings. The court discussed and distinguished apparently conflicting authority and held that plaintiffs were only indirectly affected by the proposed drain and were not proper parties to improvement proceedings since the lateral drain would replace an existing private tile drain. If, however, the lateral drain had required a new outlet into the existing ditch, landowners along the ditch would be proper parties and notice would be required. The court also noted that plaintiffs still had an adequate remedy through petition for separate proceedings for improvement of the existing ditch. (Liptak-Florida)
W70-08759

PIGORSH V FAHNER (RIGHT TO USE AND OWNERSHIP OF NON-NAVIGABLE WATERS).

177 NW2d 466-470 (Mich Ct App 1970).

Descriptors: *Michigan, *Public rights, *Riparian rights, *Non-navigable waters, Easements, Judicial decisions, Legal aspects, Legislation, Local governments, Ownership of beds, Preferences (Water rights), Prescriptive rights, Proprietary power, Recreation, Relative rights, Riparian land, Riparian waters, State governments, Usufructuary rights, Water rights, Watercourses (Legal), Lakes, Navigable waters.

Plaintiffs fenced off the entrance road to their private lake. They had allowed their friends and neighbors access to the lake, without express permission, for more than ten years. Defendant city officials removed the fence, contending that plaintiffs had dedicated the road to public use. Plaintiffs sought to enjoin defendants from further similar action. While suit was pending, plaintiffs spread dirt fill into the lake. The state then intervened as a party defendant on two grounds: (1) that plaintiffs violated a statute requiring a permit to deposit dirt fill in any navigable water body, and (2) that the public had a right to use of the lake for recreational purposes because it was navigable. The court refused both the state's contentions, holding that the term navigable waters means waters capable of being used by the public as thoroughfares for the purposes of commerce, travel and transportation. Plaintiff's lake was landlocked, and consequently was subject to their exclusive use and possession. It was clearly non-navigable and not subject to public use. The court further held that the access road may well have been dedicated to public use, but since its only useful purpose was to provide access to the lake, which was inacessible to the public, defendants could have no valid reason to pursue this claim. (Clarke-Florida)
W70-08760

ESSEX CO V GOLDMAN (ENFORCEMENT OF COVENANT TO PURCHASE WATER).
258 NE2d 526-530 (Mass 1970).

Descriptors: *Massachusetts, *Water costs, *Rent, *Industrial water, Water users, Water demand, Costs, Mills, Industrial plants, Facilities, Canals, Dam design, Surface waters, Mill dams, Water supply, Land use, Judicial decisions, Legal aspects, Canal design, Canal construction, Water utilization.

Plaintiff dam owner and water supplier sought enforcement of a covenant to pay rent for water supplied by plaintiff to land owners. Plaintiff had built a dam and canals in order to supply water for mill operation and had created a perpetual covenant for the rents to run with the land where the mills were located. Defendants, ultimate grantees of the land on which a mill was located, who did not use the water for mill operation, argued that the covenant was personal to the original grantees and thus not in force as to them. Defendants further claimed that abandonment of the use of land for mill operation constituted a radical change and that therefore the covenant was not binding. The Supreme Judicial Court of Massachusetts, affirming the trial decision for plaintiff, ruled that the covenant to pay rent for water ran with the land and was not personal in nature. The court also held that non-use of the water for mill power was not an abandonment since the water was still used for industrial purposes. (Barker-Florida)
W70-08761

LOCHTE V CICCARELLI (ACCESS TO WATER).
270 App Div 798, 60 NYS2d 126-127 (1946).

Descriptors: *New York, *Access routes, *Navigable waters, *Non-navigable waters, Water policy, Judicial decisions, Legal aspects, Roads, Lake Ontario, Bodies of water, Surface waters, Great Lakes, Ponds, Easements, Relative rights.
Identifiers: *Way of necessity.

In a per curiam decision where facts were not stated, the Supreme Court of New York, Appellate Division, ruled that it was error to deny a way of necessity from defendant's land across plaintiff's land to Lake Ontario based only on a finding that a

pond next to defendant's land which connected with Lake Ontario was navigable, when it was shown that the pond had not been used for navigation since 1890. The access route across plaintiff's land to Lake Ontario was granted. (Barker-Florida)
W70-08762

MOYER V NEW YORK (WATER SEEPAGE DAMAGE FROM STATE BARGE CANAL OPERATIONS).

50 NYS2d 203-208 (Ct Cl 1944).

Descriptors: *New York, *New York State Barge Canal, *Explosives, *Canal seepage, Damages, Seepage, Dams, Dikes, Canals, Drainage, Ditches, Surface drainage, Construction, Operations, Land use, Farms, Judicial decisions, Remedies, Legal aspects, Excavation, Crop production, Adjudication procedure, State governments, Maintenance.
Identifiers: Negligence, Causes (Legal).

Plaintiff landowners sought to recover damages to their property allegedly caused by defendant's negligent operation of the New York State Barge Canal. Plaintiffs claimed that water seepage from drainage ditches which flowed into the Canal was caused by defendant's blasting operations and failure to properly maintain the ditches. It was further alleged that such seepage diminished the productivity of plaintiffs' property. Defendant argued that its blasting in constructing a distant dike could not have affected the ditches and further claimed that title to the ditches had been transferred long before the seepage occured, thus relieving the state of maintenance responsibility. The Court of Claims of New York, dismissing plaintiffs' claim, ruled that in an action for water seepage damage from negligent operations of a canal, it must be shown that the state's operation directly contributed to the damage. The court held that the evidence was insufficient to support the claim. (Barker-Fla)
W70-08763

IN RE WATERFRONT AND HARBOR, EAST RIVER, BOROUGH OF MANHATTAN, CITY OF NEW YORK (COMPENSATION FOR CONDEMNATION).

268 App Div 131, 49 NYS2d 474-477 (1944).

Descriptors: *New York, *Cities, *Condemnation, *Riparian rights, Condemnation value, Compensation, Eminent domain, Legal aspects, Value, Water resources development, City planning, Riparian land, Governments, Construction, Docks, Relative rights, Highways, Road construction, Land use, Remedies, Judicial decisions, Property values.

In a condemnation proceeding by the City of New York for the construction of a marginal street to improve the waterfront, the landowners affected complained of uncompensated damage. Although the original plan for the marginal street was the basis of the condemnation, the landowners showed that the city contemplated a further taking in order to construct an elevated street. It was shown that the additional taking changed the property of the landowners from waterfront to inland property. The Supreme Court of New York, Appellate Division, ruled that where the original condemnation plan for the construction of a marginal street to improve the waterfront also contemplated a further taking for the construction of an elevated highway, waterfront property owners whose land was thus changed to inland property were entitled to compensation for the extinguishment of their riparian rights. (Barker-Florida)
W70-08764

NIGHTINGALE V STATE (CLAIM FOR DAMAGES DUE TO EROSION CAUSED BY CANAL OPERATION).
46 NYS2d 525-528 (Ct Cl 1944).

Descriptors: *New York, *Erosion, *Alteration of flow, *New York State Barge Canal, Canals, Damages, Remedies, State governments, Streams, Diversion, Jucicial decisions, Legal aspects, Flow rates, Legislation, Flow augmentation, Land tenure, Water transfer, Bank erosion, Accretion (Legal aspects), Intake gates, Structures, Bank erosion, Adjudication procedure.

Plaintiffs claimed that increased flow through the New York State Barge Canal had resulted in erosion of plaintiff's land adjoining the canal. The court found that, while some of the increased flow was due to seasonal rainfall, the state had contributed to the flow by diverting additional water from a near-by stream. The court held that it was unnecessary to show negligent operation of the canal; plaintiffs needed only show that through the use and management of the canal the state had damaged them. This was proven to the court's satisfaction. The fact that some part of the damage had resulted from natural causes was held not to be a bar to recovery. However, the damages had to be apportioned between natural causes and state canal operation. As the damage was a continuing wrong, plaintiffs were not bound by a short statute of limitations. The court allowed recovery. (Caldwell-Florida)
W70-08765

IN RE WATERFRONT AND HARBOR OF CITY OF NEW YORK (MUNICIPAL ACQUISITION OF WATERFRONT PROPERTY).
30 NYS2d 187-192 (Sup Ct 1941).

Descriptors: *New York, *Cities, *Condemnation, *Bulkheads, Eminent domain, Damages, Legal aspects, Rivers, Cranes, Docks, Bulkhead line, City planning, Water resources development, Legislation, Governments, Judicial decisions, Land tenure, Project planning, Remedies, Piers, Condemnation value.

The city of New York brought proceedings for the acquisition of waterfront property on the East River. The city based its action on a resolution which recommended the acquisition for the purpose of a marginal street in the interests of commerce and navigation. Owners of the property objected and argued that the proceeding was in fact one of condemnation, under which the city should offer compensation for interference with their bulkhead rights. The original bulkhead grants contained the rights of wharfage and cranage. The city claimed that because those rights had never been exercised, there was no interference therewith. The Supreme Court of New York ruled that the action was not one of condemnation, but also held that damage was done the landowners when the city took away their bulkhead rights. Therefore, the city had to pay for those damages. (Barker-Florida)
W70-08766

ROBB V STATE (NEGLIGENT CANAL STRUCTURE AS CAUSING SEEPAGE FLOODING GRAVEL PITS).
262 App Div 37, 28 NYS2d 107-108 (1941).

Descriptors: *New York, *Groundwater movement, *Canal construction, *Canal seepage, Percolation, Flood damage, Canal embankments, Groundwater barriers, Overlying proprietor, Surface-groundwater relationships, Legal aspects, Judicial decisions, Water table, Damages, Drainage, Gravels, Land tenure, Relative rights, Canals.

Plaintiff landowner claimed that negligent construction and maintenance of defendant's nearby canal had caused canal waters to seep onto his farm and flood gravel pits thereon. The trial court found that the canal seepage had raised the water level and had prevented normal drainage of plaintiff's land and gravel pit. Reversing per curiam, the appellate court held that the evidence established only that canal waters exerted pressure upon the soil beneath the canal. Such pressure prevented the groundwater from normally draining beneath the plaintiff's land. Under such circumstances, an adjacent landowner is not liable for interference with underground waters. (Caldwell-Florida)
W70-08767

VANNECK REALTY CORP V CITY OF NEW YORK (CONDEMNATION OF RIPARIAN LAND).
259 App Div 461, 19 NYS2d 544-546 (1940).

Descriptors: *New York, *Condemnation, *Compensation, *Legislation, Local governments, Riparian rights, Boundaries (Property), Eminent domain, Judicial decisions, Legal aspects, Land tenure, Proprietary power, Public rights, Relative rights, Riparian land, Riparian waters, Usufructuary right, Remedies, Highways, Condemnation value.
Identifiers: *Injunction (Prohibitory).

Plaintiff realty corporation sought to enjoin defendant city from condemning a strip of land between plaintiff's land and the East River. Plaintiff claimed that it would be deprived of riparian and wharfage rights appurtenant to its land without just compensation unless the proceedings were enjoined. Plaintiff alleged that defendant intended to use the land for a highway, yet it was proceeding under a section of the Administrative Code which related to acquisition of land for wharf purposes and other improvement of waterfront. The court held that the constitutional right to just compensation for property taken could not be flouted by a taking under the guise of an improvement, if, in fact, the taking contemplates another use. There was no reason, however, why the condemnation court could not consider all matters relevant to the question of whether plaintiff's property, including its riparian and wharfage rights, were being interfered with, even though the taking was for highway purposes. The court dismissed plaintiff's complaint without prejudice to further action. (Clarke-Florida)
W70-08768

HASKELL V STATE (NEGLIGENT OPERATION OF FLOOD CONTROL FACILITIES).

258 App Div 930, 16 NYS2d 550-551 (1939).

Descriptors: *New York, *Flood control, *Flood damage, *Dam failure, Judicial decisions, Legal aspects, Public rights, Relative rights, Riparian land, Riparian waters, Riparian rights, State governments, Usufructuary right, State governments, Watercourses (Legal), Dams, Floods, Lakes, Rivers.

The court concluded per curiam, without a statement of the facts, that damage to plaintiff's cottage property on the shore of Oneida Lake resulted from defendant state's inadequate and negligently maintained flood control facilities at its dam on the Oneida River. (Clarke-Florida)
W70-08769

BENNETT V DELAWARE COUNTY (ACTION TO FORCE CITY AND COUNTY GOVERNMENTS TO REBUILD A WASHED-OUT BRIDGE).
172 Misc 463, 15 NYS2d 591-597 (Sup Ct 1939).

Descriptors: *New York, *Bridge construction, *Local governments, *Remedies, Bridge failure, Flood damage, Bridges, Legislation, Judicial decisions, Legal aspects, Condemnation, Washouts, Cities, Institutional constraints, Streams, Land tenure, Maintenance, Adjudication procedure, Repairing.

Plaintiff, owner of land on both sides of a stream, sought to force defendant city and county governments to rebuild a bridge which had been washed out. The bridge had been the only connection between the two segments of plaintiff's land. Plaintiff argued that the destruction had the same effect as if the bridge had been withdrawn from use by condemnation for unfitness, in which case the

counties were obligated to repair it. The court rejected this argument, and held that the plaintiff could not prevail against the counties concerned since, by statute, the duty to maintain and repair bridges in the area was placed upon the municipalities. The plaintiff could force the municipal government to rebuild the bridge; however, his remedy was an administrative one under a statute providing for petition to the municipality. This remedy was exclusive so that the present action could not be maintained. (Caldwell-Florid)
W70-08770

NEW YORK WATER SERVICE CORP V WATER POWER AND CONTROL COMM'N OF DEP'T OF CONSERVATION.
257 App Div 590, 13 NYS2d 760-765 (1939).

Descriptors: *New York, *Water supply, *Well permits, *Administrative decisions, Water utilization, Groundwater, Legislation, Cities, Judicial decisions, Legal aspects, Domestic water, Water wells, Well regulations, Administrative agencies, Water demand, Water shortage, Decision making, Public benefits, Equitable apportionment, Saline water intrusion, Subsurface waters, Water table, Local governments, Drawdown, Water allocation (Policy).

Petitioner, a public water company, applied to the defendant Commission for temporary authorization to sink wells. This request was grounded on decreased capacity of existing wells due to saline water intrusion and deficient rainfall. The petition was denied, the Commission holding that the request was not justified by public necessity, and that to grant the petition would be inequitable to other municipalities. The court, noting that the Commission had made no factual findings, pointed to expert testimony to the effect that the water supply of Nassau County, which objected to the petition, would not be harmed. Also, the minimum daily water supply in the area was stated to be 165 million gallons daily, while the maximum use, even with the proposed new wells, would be 70 million gallons daily. Any lowering of the water table was stated to be due more to decreased rainfall than to any new consumption of groundwater. Therefore, the court annulled the Commission's decision as arbitrary and capricious, and remanded for further proceedings. (Caldwell-Florida)
W70-08771

HASKELL V STATE (LIABILITY FOR DAMAGES CAUSED BY INADEQUATE DAM DESIGN).
13 NYS2d 192-197 (Ct Cl 1939).

Descriptors: *New York, *State governments, *Flood damage, *Dam design, Judicial decisions, Legal aspects, Natural flow doctrine, Public benefits, Riparian land, Riparian rights, Riparian waters, Usufructuary right, Watercourses (Legal), Flood control, Damages, Overflow, Floodgates, Concrete structures, Dams, Flood protection, Floods, Rainfall, Dam failure, Canals.

Defendant state constructed a dam at the point where Oneida Lake flowed into the Oneida River. The dam contained no floodgates, and during heavy rains much of the riparian land surrounding the lake was flooded. As a result of ensuing damage claims, defendant built floodgates in the dam, and later enlarged them. Plaintiff owned land adjacent to the lake, and during a particularly heavy rainy season, his land was flooded. Plaintiff brought action for damages, claiming that defendant had raised the level of the lake by constructing the dam and had negligently failed to provide for adequate flood control. Defendant claimed that the improved floodgates constituted an adequate flood control device and that plaintiff's land was flooded by excessive rainfall and accumulated surface waters. The court found from the evidence that the floodgates were much too small and inadequate for effective flood control and that defendant had kept the gates partially closed during the heavy rainfall. The court held that lack of adequate flood control measures by defendant caused the flooding of plaintiff's land, and consequently defendant was liable for flood damages resulting thereto. (Clarke-Florida)
W70-08772

NEW YORK WATER SERV CORP V WATER POWER AND CONTROL COMM'N OF DEP'T OF CONSERVATION (REVIEW OF DECISION DENYING WELL PERMITS TO WATER COMPANY).
9 NYS2d 301-302 and 9 NYS2d 302-303 (Sup Ct 1939).

Descriptors: *New York, *Well permits, *Administrative decisions, *Drawdown, Wells, Administrative agencies, Water demand, Legal aspects, Judicial decisions, Cities, Public benefits, Water supply, Water wells, Decision making, Groundwater, Water allocation (Policy), Well regulations, Public utilities, Local governments, State governments.

Petitioner, a public water company, applied to respondent Commission for the sinking of additional wells to enable it to supply water to its customers. New York City and others filed objections on the grounds that granting such permits would deprive certain city residents of their natural water resources and that the amounts proposed to be taken would exceed the available groundwater capacity of the area. The Commission determined that, upon consideration of the present and future needs for water sources in that area, the proposed plans were unjustified. Holding that the proof submitted in connection with the objections was sufficient, the court affirmed the Commission's determination. (Caldwell-Florida)
W70-08773

IN RE NEPTUNE AVE IN CITY OF NEW YORK (DAMAGES IN CONDEMNATION PROCEEDINGS).
254 App Div 690, 3 NYS2d 825-827 (1938).

Descriptors: *New York, *Cities, *Condemnation value, *Riparian rights, Condemnation, Compensation, Eminent domain, Legal aspects, Value, Appraisals, Water resources development, City planning, Riparian land, Structures, Construction, Governments, Judicial decisions, Permits, Administrative agencies, Regulation, Easements, Relative rights, Remedies.

In a condemnation proceeding by City of New York to acquire title to waterfront property, landowners objected to the appraisals as inadequate. One landowner claimed special damages for the removal of a restaurant he had erected on such waterfront property. The landowner contended that such construction was a valid exercise of his riparian rights and that he had been issued a building permit by the dock commissioner. The Supreme Court of New York held that the appraisals were not sufficiently inadequate to warrant a reversal of the awards by the trial court. As to the restaurant owner, the court ruled that erection of such structure was not a proper exercise of riparian rights, that a permit allowing such construction was beyond the authority of the dock commissioner, and that even if the permit had been legal, it was revocable at will and thus conveyed no right, privilege, or easement which was taken away by the condemnation proceedings. The trial court's judgements were affirmed. (Barker-Florida)
W70-08774

MOYNEHAN V STATE (ESTABLISHING THE STATE'S LIABILITY FOR FLOOD DAMAGE).
1 NYS2d 907-908 (Ct Cl 1938).

Descriptors: *New York, *Overflow, *Creeks, *Rainfall intensity, Rain, Rainfall, Artificial watercourses, Backwater, Canals, Cutoff, Flooding, Non-navigable waters, Obstruction to flow, Streams, Cultivated lands, Natural flow, Water conveyance, Water spreading, Legal aspects, Judicial decisions, Watercourses (Legal), Rainfall-runoff relationships, Flood damage, Damages.

Plaintiff's cultivated land was flooded and damaged when a creek, abutting her property and flowing into a canal built by defendant state, overflowed during heavy rains. Plaintiff filed her claim in negligence and trespass against defendant for damages, alleging that the flooding was due to water backing out of the canal into the creek, causing it to overflow. The court stated that to create legal liability against the state, facts must be proved that would create legal liability against an individual or a corporation in like circumstances. There can be no recovery for damages resulting from a public improvement effected under legislation authority in the absence of any trespass or negligence. The court found that defendant had no control over the creek, and consequently could not be held responsible for the damages resulting from overflow without proof of some wrongful act on its part. The court held that the burden of establishing defendant's liability was on plaintiff, and such burden had not been met. The court further held that the overflow and flooding had been caused by the heavy rains. (Price-Florida)
W70-08775

LOHMEYER V STATE (FLOOD DAMAGE CAUSED BY DEBRIS BLOCKING ARCHWAY OF STATE AQUEDUCT).
299 NYS 681-682 (App Div 1937).

Descriptors: *New York, *Aqueducts, *Obstruction to flow, *Flood damage, Damages, Canals, Administrative agencies, Floods, Legal aspects, Judicial decisions, Flow, Flooding, Overflow, State governments, Water conveyance.

Defendant state had maintained a certain aqueduct over the Erie Canal for many years. Over a period of time, several of the archways over the canal became clogged with sand, gravel and other debris. When floodwaters were backed up by the obstruction onto plaintiffs' land, they brought suit for damages. The appellate court held per curiam that the evidence was sufficient to establish that the canal authorities had known about the condition and had been negligent in removing it. The lower court judgment for the plaintiffs was affirmed. (Caldwell-Florida)
W70-08776

NORTHERN NEW YORK POWER CORP V STATE (CLAIMS ARISING FROM DAM CONSTRUCTION WHICH NECESSITATED REBUILDING OF A POWERPLANT).
298 NYS 688-717 (Ct Cl 1937).

Descriptors: *New York, *Canals, *Dams, *Hydroelectric plants, Water utilization, Water rights, Industrial use (Water), Relative rights, Legal aspects, Judicial decisions, Eminent domain, Land tenure, Riparian land, Rivers, Governments, Water allocation (Policy), Compensation, Low flow augmentation, Outlets, Surplus water, Hydraulics, Damages, Water level fluctuations, Intake gates, Power head, Water levels.

Defendant state constructed a new dam to replace its old one across a canal. This necessitated the rebuilding of plaintiff's powerplant to take advantage of the increased operating head provided by the raised water level. Plaintiff claimed damages. The court granted damages for 2 parcels of land taken by the dam construction, but disallowed plaintiff's claim for his expense in relocating and rebuilding his powerplant. Such consequential damages were compensable, the court held, but must be balanced against the benefits the plaintiff received from the new dam. The higher head and increased aperture of the new dam had increased the power potential of plaintiff's mill to such an extent as to more than offset any possible damage. The state filed a cross-claim, alleging that plaintiff was entitled to use only so much water as could

escape through the apertures of the old dam, and sought to charge plaintiff for the excess over that amount he had used from the new dam. The court denied this claim, holding that plaintiff had a right to use all the surplus waters not actually needed for the operation of the canal. (Caldwell-Florida)
W70-08777

BELL V CITY OF NEW YORK (INJUNCTION AGAINST BUILDERS OF A SEWER IN A CANAL TO PREVENT DESTRUCTION OF RIPARIAN RIGHTS).
250 App Div 564, 294 NYS 852-855 (1937).

Descriptors: *New York, *Sewers, *Canals, *Riparian rights, Competing uses, Judicial decisions, Legal aspects, Damages, Riparian land, Riparian water, Navigable water, Navigation, Sewage, Construction, Obstruction to flow, Adjudication procedure, Cities, Local governments.

Plaintiff owner and plaintiff lessee of property fronting on a canal sought to enjoin defendants, New York City and its contractor, from laying a sewer in the canal. It was contended that the sewer was to be constructed in such a way as to interfere with plaintiffs' riparian rights. Plaintiffs alleged that the sewer pipe was being placed at a depth which would obstruct the free and proper use of the canal and thereby lessen the value of the plaintiffs' property. Defendant contended plaintiffs had not alleged sufficient facts to show that the construction of the sewer interfered with their rights of navigation. The appellate court held that the plaintiffs did not need to plead the exact measurements of the sewer, that the facts pleaded were sufficient, and that the lower court had improperly dismissed the complaint. The judgment below was reversed. (Price-Florida)
W70-08778

HOMES, INC V ANDERSON (RIGHT TO DIRECT DRAINAGE WATER ALONG NATURAL COURSE OF FLOW).
235 So 2d 680-684 (Miss 1970).

Descriptors: *Mississippi, *Drainage systems, *Natural flow, *Drainage effects, Surface drainage, Construction, Dams, Ponds, Real property, Land tenure, Judicial decisions, Legal aspects, Rainfall, Excessive precipitation, Surface runoff, Riddance (Legal aspects), Silting, Drainage water, Controlled drainage, Relative rights, Remedies.

Defendant owned land adjacent to and at a higher elevation than plaintiff's land. In preparation for construction of a subdivision, defendant cleared his land and installed a drainage system. The drainage system directed surface waters along a watercourse to a pond on plaintiff's land. After heavy rains much silt was washed into the pond and damaged a dam which was part of the pond. Plaintiff sought damages and an injunction requiring alteration of the drainage system so that none of its waters would be directed across plaintiff's land. The lower court held for plaintiff, but the Mississippi supreme court reversed. The court found that the drainage system in no way changed the course of natural drainage flow and only drained defendant's land more efficiently. An upper landowner may increase the flow of drainage water off his land as long as he does not gather it into an artificial channel. Further, plaintiff's damages were cuased by unprecedented heavy rainfalls. That, together with the fact that plaintiff prevented defendant from repairing the dam at gunpoint, precluded any damages. (Hubener-Florida)
W70-08779

BALLARD FISH AND OYSTER CO V GLASER CONSTR CO (COMPENSATION FOR TAKING OF PRIVATE PROPERTY).
424 F2d 473-475 (4th Cir 1970).

Descriptors: *Virginia, *Eminent domain, *Condemnation, *Federal jurisdiction, Compensation, Oysters, Aquatic life, Commercial shellfish, Rivers, Natural gas, Construction, Judicial decisions, Legal aspects, Adjudication procedure, State governments, Right-of-way, Easements, Relative rights.
Identifiers: *Oyster bed.

Plaintiff brought action against defendants, a construction company and natural gas corporation, for damages caused by the laying of a gas pipeline through plaintiff's oyster bed in the James River. Plaintiff alleged that defendants had been authorized by the state to exercise the power of eminant domain, and the occupancy of the oyster bed, without condemnation or acquisition of an easement, constituted an unlawful taking of private property without just compensation. The district court dismissed the action for want of a federal question. The court of appeals reversed and held that a public service corporation acts as an agent of the state when exercising the eminent domain power and must provide compensation for property which is appropriated. The occupancy of the oyster bed was not a simple trespass but a taking of property, and a federal question was raised since no provision was made by the state for payment of compensation. Plaintiff was not required to exhaust state remedies because of the absence of compensation provisions and the failure of the state to institute proceedings. (Hubener-Florida)
W70-08780

VILLAGE OF SCHOHARIE V COONS (ACQUISITION OF EASEMENT BY PRESCRIPTIVE RIGHT).

309 NYS2d 545-547 (App Div 1970).

Descriptors: *New York, *Cities, *Conduits, *Tile drains, Drainage systems, Prescriptive rights, Easements, Legal aspects, Judicial decisions, Drainage water, Surface waters, Water conveyance, Waste water disposal, Land tenure, Relative rights, Discharge (Water), Surface runoff, Flooding, Local governments.

Defendant purchased a tract of land in plaintiff village. Defendant subsequently discovered a tile conduit running across his land which formed part of the surface drainage system of the village. Defendant complained to plaintiff that the tile was discharging detergent from a nearby laundry as well as drainage water onto his land, but received no response. Thereupon, defendant took his bulldozer, crushed the tile and buried it. After flooding occurred because of the destruction of the conduit, plaintiff brought action to require restoration of the conduit, contending that it had acquired a prescriptive easement. The lower court held that hostile, actual, notorious, exclusive and continuous possession was required to establish a prescriptive easement and that plaintiff had not established hostile possession because permission had to be presumed in the absence of written records to the contrary. The appellate court reversed, finding that the easement was hostile since the discharge of water interfered with a landowner's rights in his property. Defendant also had constructive notice of the easement and took title to the land subject to it. (Hubener-Florida)
W70-08781

COX V DRAINAGE DIST NO 27 (NOTICE OF HEARING BY DRAINAGE DISTRICT REQUIRED FOR ADDITIONAL ASSESSMENTS).
187 SW2d 887-891 (Ark 1945).

Descriptors: *Arkansas, *Drainage districts, *Assessments, *Adjudication procedure, Administration, Drainage systems, Judicial decisions, Governments, Legislation, Taxes, Laterals, Financing, Construction, Drains, Ditches, Pipes, Maintenance costs, Replacement costs, Planning, Public benefits, Administrative decisions, Maintenance, Administrative agencies.

Defendant drainage district filed a petition in county court stating that, in order to preserve and maintain the drainage ditches and drainage system constructed by them, it was necessary to issue bonds. The proceeds from the bonds would be used to complete the work of improving, cleaning out, deepening and widening its drains, constructing culverts and openings where needed, and performing other necessary maintenance work. In order to pay the principal and interest of these bonds, it was necessary that a tax be levied on the assessed benefits of the district. Without giving any notice of a hearing on the petition, as required by statute, the county court entered an order granting the petition. Plaintiff landowners of the district appealed to the circuit court which affirmed the county court order. The supreme court reversed, stating that if additional laterals are to be constructed, or if an additional assessments of benefits is required to pay for such improvements, the statutory requirements for notice to the property owner must be observed. (Barnett-Florida)
W70-08782

OLSON V PRESTON STREET WATER DIST NO 1 (PURCHASE OF WATER PLANT OUTSIDE DISTRICT).
291 Ky 155, 163 SW2d 307-309 (1942).

Descriptors: *Kentucky, *Public utility districts, *Cities, *Municipal water, Local governments, Economics, Public utilities, Water works, Judicial decisions, Legal aspects, Planning, Water supply, Water utilization, Costs, Water costs, Water demand, Legal aspects, Legislation, Supervisory control (Power), Administrative agencies, Administrative decisions.

Plaintiff, as a taxpayer and resident in defendant water district, sued to enjoin the commissioners of the district from putting into effect a plan to buy a water plant which would supply members of the district. The plant was situated partly within and partly outside of defendant district. The court gave judgment for plaintiff, holding that state statute prohibited the district from purchasing a water supply plant that was not located wholly within the district's boundaries. The court acknowledged the many benefits purchase of the existing plant would provide, such as increased water pressure, more efficient circulation, assured sales and reduced insurance rates, and suggested that the district follow prescribed procedures to extend its boundaries. (Hubener-Florida)
W70-08783

NASHVILLE WATER CO V DUNLAP (EMINENT DOMAIN AS AN INDICATION OF PUBLIC PURPOSE).
138 SW2d 424-428 (Tenn 1940).

Descriptors: *Tennessee, *Eminent domain, *Administrative agencies, *Regulation, Administrative decisions, Community development, Condemnation, Contracts, Judicial decisions, Legal aspects, Legislation, Local governments, Public rights, Public benefits, Relative rights, State governments, Taxes, Public utilities, Water works.
Identifiers: *Public purpose.

Defendant, commissioner of the Public Utilities Commission, attempted to regulate plaintiff water company and to assess it for tax purposes. A state statute authorized defendant to so regulate and tax water companies as public utilities. Despite its state charter, which conferred upon it, among other things, the power of eminent domain, plaintiff contended that it was not a water company within the meaning of the statue because it acquired its pipelines from private individuals and corporations which had previously operated as real estate development organizations. The court held that the acceptance of a charter conferring powers of eminent domain is a profession of public purpose. Plaintiff's acceptance of the charter was a voluntary act, and as long as it operated under such charter, it could not claim that its properties were

not affected by a public use. Plaintiff was accordingly found to be a public water company within the meaning of the statue, and thus subject to regulation and taxation by defendant. (Clarke-Florida)
W70-08784

GRAVES V LITTLE TARKIO DRAINAGE DIST NO 1 (FINANCING RECLAMATION PROJECTS).

134 SW2d 70-81 (Mo 1939).

Descriptors: *Missouri, *Administrative decisions, *Drainage districts, *Land reclamation, Boundaries (Property), Community development, Legal aspects, Judicial decisions, Legislation, Proprietary power, Public benefits, Relative rights, Right-of-way, State governments, Water transfer, Taxes, Controlled drainage, Surface drainage, Ditches, Drainage systems, Flood control, Laterals, River systems, Levees, Dikes, Financing.

Pursuant to a reclamation plan and statutory authority, defendant drainage district constructed several large drainage ditches and appurtenant works. Between 1910 and 1937 defendant substantially repaired and enlarged the works. The construction was paid for by warrants issued to contractors. The warrants were financed by several levies of a maintenance tax which the district supervisors were statutorily authorized to collect from landowners within the district for the purpose of repairing and improving the works. In seeking to enjoin the collection of the maintenance tax, plaintiff landowners claimed that the improvements to the works were not within the original plan of reclamation and, in fact, constituted the construction of a completely new drainage system. Defendant admitted that the improvements were more than contemplated by the original plan, but claimed that plaintiffs had had full knowledge of the construction of the system as it existed and had benefited from it for twenty-seven years. Defendant pleaded laches and estoppel. The court granted defendant's plea of laches. The court further stated that provisions of drainage acts should be construed broadly and liberally. The court found that most of the construction performed after 1910 was within the powers of the district supervisors to maintain and protect the plan for reclamation. Plantiff's injunction was denied. (Clarke-Florida)
W70-08785

MIDDENDORF V JAMESON (RIGHT TO ISSUE REFUNDING BONDS).
265 Ky 111, 95 SW2d 1057-1059 (1936).

Descriptors: *Kentucky, *Public utility districts, *Depression, *Assessments, Economics, Local governments, Real property, Public utilities, Water works, Judicial decisions, Legal aspects, Financing, Cities, Planning, Income, Interest, Land tenure, Water users, Water supply, Cost repayment, Debt.

Commissioners of a water district issued and sold assessment bonds to pay for the acquisition of a water plant. The bonds were payable solely out of the assessments against property in the water district. Because of the financial depression of the 1930's, the owners in the district were unable to pay assessments. This action was instituted for a declaration of the right of the board of commissioners to issue and sell refunding bonds pursuant to a state statute. The court, interpreting the statute, held that the water district was not subject to the jurisdiction of the Kentucky Public Service Commission and was empowered to issue refunding bonds payable by assessments on property within the district. (Hubener-Florida)
W70-08786

HOGAN V COWART (DUTY NOT TO OBSTRUCT DRAINAGE THROUGH DITCH ACQUIRED BY EASEMENT).
184 SE 884-886 (Ga 1936).

Descriptors: *Georgia, *Obstruction to flow, *Prescriptive rights, *Easements, Real property, Damages, Remedies, Judicial decisions, Legal aspects, Drainage, Drainage practices, Drainage water, Ditches, Surface waters, Excess water (Soils), Water injury, Cultivation, Flow, Relative rights, Repulsion (Legal aspects), Land tenure.
Identifiers: *Trespass (Continuing).

Plaintiff and defendant were conveyed adjoining tracts of land from a common owner. A drainage ditch extended from plaintiff's property through the adjoining land of defendant. For more than twenty years plaintiff and her predecessor in title had continuously used the ditch to drain water from plaintiff's land. By plowing over and filling it, defendant obstructed the flow of water through the ditch, thus preventing drainage of plaintiff's property. Plaintiff sought injunctive relief to prevent future obstruction of the ditch, and sought damages to cultivation caused by such obstruction. As plaintiff's adverse use of the ditch was for more than twenty years, the court found that she had acquired an easement by prescription in such ditch. In granting the injunction and damages, the court held that defendant had committed a continuing trespass in closing the ditch and was therefore liable to the extent of the injuries which plaintiff incurred as a result of the obstruction to flow. (Finman-Florida)
W70-08787

LEGISLATIVE DISCOURAGEMENT OF MAINE'S MARINE INDUSTRIAL GROWTH.

Maine Law Review, Vol 22, 1970. p 265-282.

Descriptors: *Maine, *Harvesting of algae, *Marine algae, *Legislation, Aquatic algae, Ecology, Aquatic plants, Aquatic life, Marine plants, Natural resources, Conservation, Submerged Lands Act, Oceans, Coasts, Beds, Submerged plants, Harvesting, Research and development, Aquatic environment, Economics, Environment.

Existing law in Maine as to the control of the cultivation, conservation, and harvesting of marine algae is embodied in its Research and Development Statute. Under this statute only a limited portion of the state's ocean floor is subject to state control over the utilization of marine algae. The vast majority of the state's ocean floor is unaffected by the statute. The author asserts that this statute is representative of Maine's inadequate and piecemeal treatment in the area of marine resources control. The author attacks Maine's laws as unprogressive and insufficient to recognize the state's responsibility in the area of developing, controlling, and utilizing the resources of its ocean floor. The author calls for a comprehensive and unified program in the entire area of marine resources so as to insure a well-organized and complete development of Maine's ocean resources. (Snow-Florida)
W70-08788

HUEY V STATE (NO RIGHT TO DAMAGES FOR DIVERSION OF UNDERGROUND WATER SUPPLY).
170 Misc 677, 11 NYS2d 195-198 (Ct Cl 1939).

Descriptors: *New York, *Excavation, *Underground streams, *Diversion, Water wells, Obstruction to flow, Foundations, Wells, Land, Acreage, State governments, Bridge construction, Highways, Piers, Water supply, Water demand, Water sources, Livestock, Damages, Appropriation, Right-of-way, Legal aspects, Judicial decisions, Surface waters.

Plaintiff landowner conveyed several acres of land to county authorities who provided this land to defendant state for defendant's construction of a highway. Defendant began excavating for the foundation of a bridge pier, whereupon its contractor struck quicksand and an underground stream. Plaintiff's two wells, which were located one hundred feet and two hundred fifty feet respectively from defendant's excavating operation, ran dry. In a suit for damages, plaintiff claimed the destructi of his two wells amounted to an additional ap propriation of his property and was the direct resu of defendant's construction work. Defendant maint tained its contractor was not negligent nor did h have any knowledge of an underground strean The court held plaintiff could not recover damage to his property, as defendant only performed it duly authorized work on its own right of wa Moreover, the court noted that state law denied lia bility for the diversion of underground water where there was no adverse effect on surfac waters nearby. (Finman-Florida)
W70-08790

BD OF EDUC V TOWN OF N HEMPSTEAD (LIABILITY FOR DIVERSION OF SURFACE WATERS).
259 App Div 732, 18 NYS2d 433-434 (Sup C 1940).

Descriptors: *New York, *Drainage systems *Drainage engineering, Abatement, Drainage effects, Remedies, Drainage practices, Drainage water, Drainage, Cities, Construction, Surface waters, Culverts, State governments, Legal aspects, Judicial decisions, Damages, Water injury, Controlled drainage, Operations, Local governments, Surface runoff.
Identifiers: *Nuisance (Continuing), *Trespass (Water).

Defendant construction company built a drainage system for defendant town pursuant to the construction of city streets. Plaintiff school district alleged that the drainage system was a continuing nuisance, which caused surface waters to accumulate and pass over its lands. Plaintiff brought action to abate the alleged nuisance and to enjoin trespassing upon its lands. Defendants maintained that the waters which passed over plaintiff's lands had come from a culvert constructed by the state. The court stated that even if defendant construction company had created a nuisance from which plaintiff had suffered, it was not liable since it had dedicated the streets containing the drainage system to defendant town, and such dedication did not carry with it any warranties or inference that the drainage system was to be continued in any particular form. Moreover, the court noted evidence which showed that the instrumentality from which waters were cast upon plaintiff's lands was constructed and controlled by the state. Therefore, plaintiff's injunction was denied. (Finman-Florida)
W70-08791

BONDY V UTAH CONSTR CO (TUNNEL CONSTRUCTION INTERFERING WITH UNDERGROUND STREAMFLOW).

23 NYS2d 125-126 (Sup Ct 1940).

Descriptors: *New York, *Underground structures, *Water wells, *Tunnel construction water demand, Underground streams, Damages, Contracts, Condemnation, Cities, Legal aspects, Judicial decisions, Construction, Easements, Land, Water supply, Water users, Water shortage, Streams, Streamflow, Water injury, Tunnels, Tunneling, Remedies, Subsurface waters.
Identifiers: *Injunction (Temporary).

In order to construct a tunnel, the City of New York obtained a tunnel easement in condemnation proceedings to certain subterranean lands. Defendant contracted with the city to build such tunnel. After commencement of construction by defendant, wells on plaintiff's lands ran dry. Plaintiffs were deprived of water for necessary household purposes, and their buildings were subsequently rendered uninhabitable. Plaintiffs claimed that defendant's activities in connection with the construction of the tunnel caused interference with the subterranean streams of water which fed their wells and, therefore, sought a temporary injunction requiring defendant to immediately supply plaintiffs with water. The court stated that defendant

had done nothing except construct a tunnel according to its contract and pursuant to the right of the city, which was obtained in condemnation proceedings. The rule being well-settled that the interference with subterranean veins of water as the result of a lawful use of one's own property was damnum absque injuria and could not become the ground of an action, the court held that plaintiffs were not entitled to a temporary injunction. (Finman-Florida)
W70-08792

MENNITO V TOWN OF WAYLAND (LIABILITY FOR DAMAGES RESULTING FROM THE ALTERATION OF SURFACE DRAINAGE).

56 NYS2d 654-675 (Sup Ct 1943).

Descriptors: *New York, *Roads, *Cities, *Surface drainage, Drainage, Drains, Muck soils, Judicial decisions, Legal aspects, Reasonable use, Field crops, Flood control, Overflow, Farm management, Crops, Hydrographs, Drainage practices, Surface waters, Streams, Ditches, Drainage engineering, Outlets, Culverts, Pipes, Streamflow, Surface runoff, Storms, Alteration of flow, Natural flow.

Plaintiff owned farm lands adjacent to defendant city's roadway. Prior to defendant's widening and surfacing the road, there were adequate means of drainage for excess surface waters that resulted from heavy rains and from the resulting overflow of a stream which bounded plaintiff's lands. Plaintiff alleged that defendant, when improving the roadway, diverted the excess surface water from the course of its natural flow by constructing drains and culverts to allow adequate drainage for the road. Plaintiff further alleged that defendant negligently constructed these drainage facilities and as a result caused the diverted waters to be discharged upon his land, causing damage to the fee and his crops. Defendant contended that the storm which caused the complained of damages was unprecendented and constituted an 'Act of God.' The court, in holding for plaintiff, stated that any natural or normal alteration of the surface of one's land, resulting in the casting of surface waters upon the land of another through drains or other artificial channels, is a trespass for which damages will lie. (Barnett-Florida)
W70-08793

TAYLOR V STATE (RIGHT TO DIMINUTION OF RENTAL VALUE FOR FLOOD DAMAGES).
59 NYS2d 189-190 (Ct Cl 1946).

Descriptors: *New York, *Damages, *Flood damage, *Rent, Floodwater, Flood control, Flooding, Lakes, Land, State governments, Legal aspects, Judicial decisions, Buildings, Reservoirs, Costs, Replacement costs, Value, Diversion, Watercourses (Legal), Water injury, Surface waters, Percolation, Real property.

Plaintiff landowner sought damages to his land and buildings due to floodwaters from a lake. There was no question as to the liability of defendant for the cost of restoration of plaintiff's premises. The disputed issue was whether or not plaintiff could receive damages for the loss of rental of two cottages as a result of such flooding. The court held that plaintiff was entitled to damages due to the loss of rental of the two cottages since they had been customarily used for rental purposes. Moreover, the court stated that as a general rule, where lands are flooded by the wrongful diversion of a water course, by collection of surface waters on premises or by percolation of waters from a reservoir, damages are measured by the diminution in the unable or rental value of the land to the time of the commencement of the action. (Finman-Florida)
W70-08794

TENNESSEE A AND G RY V CARDON (DUTY TO MAINTAIN ADEQUATE DRAINAGE AFTER CONSTRUCTION OF DITCHES).
7 Div 272, 177 So 171-172 (Ala 1937).

Descriptors: *Alabama, *Diversion, *Obstruction to flow, *Surface drainage, Embankments, Erection, Construction, Ditches, Right-of-way, Surface waters, Properties, Damages, Legal aspects, Judicial decisions, Maintenance, Drainage systems, Crops, Overflow, Overland flow, Remedies, Drainage effects, Railroads, Maintenance.
Identifiers: *Railroad roadbeds.

Defendant railroad constructed a roadbed on a right-of-way adjacent to plaintiff's upper lands. In constructing the roadbed, defendant erected embankments but also dug ditches in order to keep surface waters from backing up onto plaintiff's lands. When kept clear of obstructions, the ditches adequately drained surface waters. They became clogged, however, and as a result, surface waters were diverted back upon plaintiff's property, causing damages to his lands and destruction of his crops. Plaintiff contended that after he gave notice of such condition, defendant allowed it to remain. Therefore, plaintiff brought an action for damages. Defendant denied its liability for damages to plaintiff. The court stated that in acquiring the right-of-way, defendant secured certain rights but also assumed corresponding burdens. The court held it was defendant's duty to construct, as well as maintain, a drainage system adequate to allow free flowage of surface waters and to prevent the accumulation of such surface waters upon plaintiff's lands. Since it had failed to execute these duties, defendant was held to be liable for plaintiff's damages. (Finman-Florida)
W70-08795

LEHNER V KOZLOWSKI (RIGHT TO RELOCATE DRAINAGE DITCH ACROSS ADJOINING LAND).

245 Wis 262, 13 NW2d 910-913 (1944).

Descriptors: *Wisconsin, *Obstruction to flow, *Tile drains, *Drainage systems, Relocation, Contracts, Drains, Ditches, Legal aspects, Judicial decisions, Remedies, Drainage, Drainage effects, Construction, Marshes, Overflow, Surface waters, Agriculture, Culverts, Real property, Flow, Flow control, Easements, Relative rights.
Identifiers: *Trespass (Land), Injunction.

With the hope of redeeming some of his marshland for agricultural purposes, plaintiff constructed a tile drain pursuant to a written contract with defendant's predecessor in title. The drain extended from plaintiff's land across the property owned by defendant at the time of trial. In an effort to improve the drainage of surface waters, plaintiff subsequently constructed a new, open ditch across defendant's land without defendant's consent. Such construction caused surface waters to overflow onto a road running through defendant's land, thereby making such road unusable. Defendant constructed a culvert in order to maintain the road in a usable condition, and the culvert caused an obstruction to the flow of waters through the new ditch. As a consequence, plaintiff commenced suit to enjoin the obstruction. In constructing the new ditch, plaintiff contended he was acting within the scope of the written contract, which granted plaintiff an easement for the purpose of establishing a drainage system across defendant's land. The appellate court, in affirming the lower court decision for defendant, held that the contract had created a drainage easement. However, plaintiff was bound by his earlier choice of atile drain and could not construct an open ditch in a new location. In so doing, plaintiff trespassed on defendant's land. (Finman-Florida)
W70-08796

LAND MANAGEMENT IN MUNICIPAL WATERSHEDS,
W. W. Jeffrey, and B. C. Goodell.
American Water Works Association Journal, Vol 62, june 1970, p 380-384.

Descriptors: *Forest management, *Watershed management, *Water yield, *Land management, Reservoirs, Flooding, Clear-cutting, Vegetation effects, Recreation, Hydrologic cycle, Habitat improvement, Municipal water, Water pollution, Multiple-purpose projects, Water conservation, Public health, Water quality, Water pollution sources, Flow augmentation, Land management, Wildlife management, Lumbering, Sediment control, Watersheds (Basins), Reforestation, Evapotranspiration control.
Identifiers: *Catchments basins, *Logging.

With the need for more and better planning of watershed areas, the concept of multiple use land management has become necessary. The purpose of this concept is to combine multiple uses that are compatible on the same land areas. Emphasis herein is placed on land use in forested municipal watersheds. Timber resources are highly compatible with water production of high quality and adequate quantity. Deforestation of a watershed, in a well-planned scheme, can be beneficial by increasing the water yield of that area. The removal of trees stops the evapotranspiration process and removes the major interceptors of rain and snow, thus allowing a greater water yield. Proper synchronization of deforestation can also improve the stream-flow regime and allow for proper forest conservation as well. A major factor to guard against in such procedures, however, is the impairment of water quality by the soil disturbances associated with logging. Other safeguards against pollution sources such as herbicides, fertilizers and machinery wastes must be utilized. The recreational use of watersheds is found to be compatible with the objective of quality water production and should be prohibited. Selected experiences in timber resource management on municipal watersheds are also examined. (Barnett-Florida)
W70-08797

STRUCTURE OF PUBLICLY-OWNED WATER UTILITIES,
For primary bibliographic entry see Field 06C.
W70-08799

PLANNING FOR WATER QUALITY EMERGENCIES,
T. F. Craft.
American Water Works Association Journal, Vol 62, March 1970, p 181-184.

Descriptors: *Future planning (Projected), *Water pollution control, *Water management (Applied), *Water supply, Planning, Decision making, Impaired water quality, Water demand, Fluctuation, Flow control, Disasters, Watersheds (Basins), Surveys, Waste disposal, Treatment facilities, Pipelines, Water pollution, Farm wastes, Radioactive wastes, Watershed management, Water purification, Coordination, Pollution abatement, Water utilization.

Planning is essential to any type of endeavor, especially in the area of water quality control. Immediate steps should be taken by responsible persons to prepare for disasters and other emergencies which might affect the available water supply. Floods, upstream pollution and spillage of pollutants into reservoirs are examples of these items. To initiate a water quality control program, a comprehensive survey of the watershed concerned should be undertaken to pinpoint possible trouble spots. Treatment plants, pipelines, petroleum tanks and farm chemical concentrations are among items which should be included in such a survey. Steps to combat pollution from each potential source should be planned in detail, and materials adequate for any emergency should be stockpiled. Officials must be trained to recognize an emergency when

one occurs. Continual coordination between responsible persons is necessary to insure the effectiveness of any plan. (Caldwell-Florida)
W70-08800

AN ENVIRONMENTAL COMMON LAW FOR MICHIGAN,
Joseph L. Sax.
L Quadrrangle Notes, Vol 14, Spring, 1970, p 27-32.

Descriptors: *Michigan, *Ecology, *Remedies, *Legislation, Environmental effects, Local governments, State governments, Administrative agencies, Legal aspects, Environment, Public health, Public rights, Relative rights, Public benefits, Natural resources, Resource development, Economics, Jurisdiction, Political aspects, Adjudication procedure.

House Bill 3055, recently introduced into the Michigan state legislature, is based on a model environmental quality bill drafted by Professor Sax. The bill authorizes the Attorney General, local governments and private citizens to go into court and challenge activities which infringe upon the right of the public to a clean, healthy and attractive environment. Such a bill would serve as the basis for the creation of a body of environmental common law more flexible, innovative and responsive than existing agencies and legal remedies. Too often agencies become single-minded about the scope of their functions, and citizens are thwarted in their legal efforts either by lack of standing to sue or by judicial deference to the agencies. The proposed bill can further expand the public suit concept whereby private citizens sue on behalf of the public to enjoin public nuisances. Heretofore, such suits have been directed largely against such targets as prostitution or gambling establishments. The right to such a suit should be available to a party who can show a reasonable likelihood of an adverse effect of some particular activity on the state's resources or environment. (Hubener-Florida)
W70-08801

AIR AND WATER POLLUTION: WHAT TO DO WHILE WAITING FOR WASHINGTON,
John C. Esposito.
Harv Civ Rights - Civ Lib L Rev, Vol 5, p 32-52, 1970. 90 ref.

Descriptors: *Water pollution, *Air pollution, *Pollution abatement, *Water pollution control, Impaired water quality, Water pollution treatment, Water pollution sources, Treatment facilities, Water pollution effects, Legal aspects, Industrial wastes, Costs, Pollutant identification, Judicial decisions, Administrative agencies, Capital costs, Public rights, Public benefits, Environmental engineering, Environmental sanitation, Governments, Regulation, Remedies.

Efforts must be made to expand judicial remedies for air and water pollution because corrective legislation is unlikely to be forthcoming in the near future. Pollution abatement is unprofitable for corporate poluters, and so such a program must be forced on them by external pressures. Private nuisance or trespass suits brought as class actions may become effective deterrents to polluters due to the large amounts of total claims. Some cases have held that failure to keep up with recent developments in pollution control devices rendered the polluter liable for punitive damages. Using a product liability theory against producers of pollution-generating items such as automobiles might yield results. Stockholder suits also promise to be effective. Courts could take a leading role in abating pollution by closely scrutinizing administrative action and issuing mandamus and injunction writs to force necessary action. It could be argued that a constitutional right to be free from pollution exists, based on the 9th amendment and the due process clause of the 14th amendment. Traditional tendencies of courts to favor business interests would militate against these arguments, however. (Caldwell-Florida)
W70-08802

EFFLUENT CHARGES AND THE INDUSTRIAL WATER POLLUTION PROBLEM,
For primary bibliographic entry see Field 05B.
W70-08803

THE RIPARIAN RIGHTS DOCTRINE IN SOUTH CAROLINA,
Edward P. Guerard, Jr.
South Carolina Law Review, Vol 21, 1969, p 757-770. 57 ref.

Descriptors: *South Carolina, *Riparian rights, *Reasonable use, *Water rights, Water policy, Ownership of beds, Prior appropriation, Prescriptive rights, Relative rights, Riparian rights, Riparian land, Riparian waters, Water utilization, Natural flow doctrine, Competing uses, Water allocation (Policy), Water resources development, Water supply, Natural watercourses, Watercourses (Legal), Water demand, Navigable waters, Water pollution, Non-navigable waters.

The doctrine of riparian rights, as adopted by the South Carolina courts, gives an inherent right to the flow of a stream in its natural course to the owner of lands bounded or traversed by such stream. Riparian rights of a proprietor exist only as to natural watercourses, a course which has defined banks and beds, notwithstanding whether or not it may at times be dry. If a natural watercourse does exist so as to invoke the applicability of the riparian rights doctrine, the extent of these rights depends on whether the stream is navigable or non-navigable, which in turn determines the ownership of the beds of such waters. Beds of tidal navigable watercourses are property of the state subject to the rights of the federal government. The ownership of the beds of non-navigable and navigable non-tidal waters lies in the owners of the adjoining properties. The riparian doctrine is further qualified by the reasonable use doctrine which determines the extent of the right of a riparian to use the water. Each riparian has equal right to make reasonable use of water subject to equal rights of other riparians to make a reasonable use. (Snow-Florida)
W70-08804

THE LIMITS OF CONTINENTAL SHELF JURISDICTION: SOME POSSIBLE IMPLICATIONS OF THE NORTH SEA CASE JUDGMENT,
R. Y. Jennings.
International and Comparative Law Quarterly, Vol 18, Oct 1969, p 819-832. 28 ref.

Descriptors: *Continental shelf, *International law, *Ownership of beds, *Judicial decisions, International waters, Beds under water, Continental margin, United Nations, Legal aspects, Conferences, International commissions, Exploitation, Boundary disputes, Boundaries (Property), Adjudication procedure, Continental slope, Geology, Geomorphology, Oceans, Topography, Marine geology.

The North Sea Case has implications concerning fundamental issues of the character and limits of continental shelf jurisdiction. While the Geneva Convention on the Continental Shelf purported to define the limits of the shelf as occurring at a depth of 200 meters, general principles of international law should provide more useful definitions. The case, which resolved a dispute among several European nations and Britain over ownership of the North Sea bed, did not concern itself with general international law principles, but affects them nonetheless. Traditionally, continental shelf jurisdiction has been described as an inalienable appurtenance of the coastal state's sovereignty over its land territory. Geomorphological considerations, that is, the physical identity between land and continental shelf, are of primary importance in determining the extent of the shelf. While the she must be adjacent to the coast, absolute proximity not a factor in determining the extent of the ju risdiction over the shelf. In light of the North Se Case, the 200 meter test must be considered holding that a coastal state's jurisdiction over th shelf extends to a depth of 200 meters, and as fa beyond that as it can be shown that the shelf is natural prolongation of the land. (Caldwel Florida)
W70-08805

INTERNATIONAL PRACTICE REGARDIN TRADITIONAL FISHING PRIVILEGES OD FOREIGN FISHERMEN IN ZONES OF EX TENDED MARITIME JURISDICTION,
David W. Windley.
American Journal of International Law, Vol 63 1969, p 49-503. 51 ref.

Descriptors: *International law, *Law of the sea *Foreign waters, *Commercial fishing, Interna tional waters, Legal aspects, Continental shelf Oceans, Aquatic life, Marine fisheries, Legislation. Atlantic Ocean, Treaties, Trawling, Fisheries. Regulation, Crabs, Tariff, Jurisdiction, Political aspects, Fishing, Fish, Relative rights.
Identifiers: *Comity.

In recent years many nations have for various pur poses extended their sovereignty or exclusive con trol beyond the three mile territorial sea tradi tionally claimed. Often the purpose is to preserve exclusive fishing rights for the coastal state or to regulate the activities of foreign fishermen. The displaced fishermen have no privilege beyond what international comity can preserve for them. Thus, at times, coastal nations recognize each other's traditional or historic fishing rights on a basis of reciprocity. In other cases governments do not recognize historic rights but, nevertheless, agree to fish in each other's coastal water pursuant to mutually acceptable provisions. The United States maintains exclusive fishing rights in a nine mile zone contiguous to its three mile territorial sea. However, it recognizes traditional fishing rights in the contiguous zone. The United States has made agreements with Russia, Japan and Mexico controlling traditional fishing rights and exploitation of the continental shelf. Some South American nations, to control foreign fishing, claim sole sovereignty over waters up to 200 miles from their coast. Also discussed are other agreements on fishing rights. They involve such countries as Russia, Iceland, Japan, South Africa, Australia and New Zealand. (Hubener-Florida)
W70-08806

INTERNATIONAL LAW AND 'THE INTERESTS': THE LAW OF THE SEABED,
Louis Henkin.
American Journal of International Law, Vol 63, 1969, p 504-510. 11 ref.

Descriptors: *Appropriation, *International law, *Jurisdiction, *Ownership of beds, Boundaries (Property), Beds under water, Boundary disputes, Equitable apportionment, Federal government, Federal jurisdiction, Governments, Legal aspects, Legislation, Political aspects, Submerged Lands Act, Treaties, International waters, Foreign waters, Oil industry, Preferences (Water rights), Priorities, Oceans, Continental shelf, Continental slope.
Identifiers: *Mineral rights.

One of the least settled areas of international law concerns coastal nations' rights to the seabed. The basic legal issues are simply stated: how far do, and should, the exclusive rights of coastal states extend; and what legal regime should govern exploitation beyond the limits of national jurisdiction. The United States has been the first to consider these questions, but it has reached no concrete conclusions. Different interests have pressed for different official positions. The National Petroleum Council advocated a position that the legal continental shelf should extend to the full limit of the continental

and mass. If all coastal nations adopted this policy, one quarter of the total ocean bed would be appropriated. The International Law Commission and the International Court of Justice would severely limit coastal boundaries. One major concern is that the accepted extension of national jurisdiction for one purpose tends to become jurisdiction for all purposes. A presidential commission has recently proposed an 'intermediate zone' in which the coastal state would have the exclusive right to exploit the resources, subject to the regime that is to govern all the seabed beyond national jurisdiction. (Clarke-Florida)
W70-08807

STATE TERRITORY--TERRITORIAL WATERS--ACQUISITION OF TERRITORIAL SOVEREIGNTY--TITLE BY DISCOVERY--TITLE TO CONTINENTAL SHELF--JURISDICTION OVER REEFS AS COMPARED WITH ISLANDS--PRIVATE PROPRIETARY CLAIMS TO REEFS--OUTER CONTINENTAL SHELF LANDS ACT, 1953--THE LAW OF THE UNITED STATES.

American Journal of International Law, Vol 63, 1969, p 642-644. 8 ref.

Descriptors: *Federal government, *Federal jurisdiction, *Ownership of beds, *Continental shelf, Boundaries (Property), Boundary disputes, Community development, Jurisdiction, Legal aspects, Judicial decisions, Proprietary power, Recreation, Relative rights, Unappropriated water, Navigable waters, Reefs, Political aspects, Construction, Recreation facilities, Rivers and Harbors Act.
Identifiers: *Outer Continental Shelf Lands Act.

Defendants wished to commercially develop as tourist attractions two reefs located 4 1/2 miles southeast of Florida. Plaintiff United States notified defendants: (1) that they were precluded from undertaking any construction in the navigable waters of the United States without the approval of the Department of the Army; (2) that the Department's authority extended to fixed structures located upon the Outer Continental Shelf; and (3) that the reefs were located within the Outer Continental Shelf. Nevertheless, defendants began construction. Plaintiff brought suit for trespass on government property and for violation of section 10 of the Rivers and Harbors Act of 1899 and section 4 (f) of the Outer Continental Shelf Lands Act of 1953, both of which required authorization of the Department of the Army before artificial structures could be erected on the outer continental shelf. The court held that the United States did not hold title to the continental shelf, only jurisdiction of the seabed. Consequently, there was no trespass, but defendants clearly violated the statutes since the reefs were found to be part of the seabed rather than islands. (Clarke-Florida)
W70-08808

UNITED STATES V LOUISIANA (LOUISIANA BOUNDARY CASE).

American Journal of International Law, Vol 63, 1969, p 832 837. 23 ref.

Descriptors: *Louisiana, *Boundary disputes, *Submerged Lands Act, *Federal jurisdiction, International law, Boundaries (Property), Federal government, Legal aspects, Legislation, Ownership of beds, Relative tights, State governments, State jurisdiction, Third party effect, International waters, Beds, Governments, Channels, Channel improvement, Bays, Islands, High water mark, Low water mark, Tidal waters, Tidal effects, Gulf of Mexico.
Identifiers: *Seabeds.

In United States v Louisiana, 394 U. S. 11 (1969), a decree was sought to determine the line marking the seaward limit of the inland waters of Louisiana. The United States contended that the Submerged Lands Act of 1953 had given to Louisiana, by quit claim deed from the United States, lands extending three miles from the state's coastline into the Gulf of Mexico. Louisiana contended that this Act did not apply to it since the boundaries of its inland waters had already been delineated by the Submerged Lands Act of 1895 and since the inland water line so delineated was a historic boundary. The Supreme Court distinguished the two Acts in that the 1895 Act was concerned with navigational waters, whereas the 1953 Act pertained to boundary matters. As to Louisiana's claim to the historic boundaries, the Court held that historic title can be claimed only when the coastal nation has traditionally asserted and maintained dominion with the acquiescence of foreign nations. In connection with this case, the Court further held that: (1) dredged channels do not constitute inland waters; (2) low tide elevations are part of the coastline; (3) a bay must be at least a semi-circle, and islands can be included as part thereof; and (4) islands realistically part of the coast can be headlands to a bay. (Clarke-Florida)
W70-08809

REFLECTIONS ON RIPARIANISM,
T. E. Lauer.
Missouri Law Review, Vol 35, 1970, p 1-25.

Descriptors: *Social aspects, *Riparian rights, *Competing uses, *Watercourses (Legal), Civil law, Industries, Judicial decisions, Legal aspects, Natural flow doctrine, Prior appropriation, Water tights, Relative rights, Municipal water, Reasonable use, Obstruction to flow, Water pollution, Water utilization, Water resources development, Governments, Water resources, Permits, Regulation, economics, Resource allocation, Legislation.

'Reflections on Riparianism' suggests possible legal solutions to the rapidly deteriorating water situation in the United States. It discusses in detail the legal technicalities of riparianism, its virtues and its drawbacks, and it explores alternatives to the riparian system including prior appropriation, the permit system, economic determinism, quantifying the water right, water development and a modified riparian system. The author concludes that an updated and modernized riparian system would be the best legal means for pre-serving and equitably distributing present and future water resources. (Clarke-Florida)
W70-08810

MODIFICATION OF THE RIPARIAN THEORY AND DUE PROCESS IN MISSOURI,
For primary bibliographic entry see Field 04A.
W70-08811

POLLUTION CONTROL: WHY HAS IT FAILED,
For primary bibliographic entry see Field 05C.
W70-08812

ZONING THE FLOOD PLAINS OF OHIO.
For primary bibliographic entry see Field 04A.
W70-08813

TERRITORIAL SEAS - 3000 YEAR OLD QUESTION.
Journal of Air Law and Commerce, Vol 36, 1970, p 73-104.

Descriptors: *International law, *International waters, *Law of the sea, *Jurisdiction, Oceans, Admiralty, International commissions, Navigation, Legal aspects, Relative rights, Foreign waters, Treaties, Ships, History, United Nations, Bays, Inland waterways, Water rights, Political aspects, Governments, Prescriptive rights, Judicial decisions, Commercial fishing.

Territorial waters, as opposed to international or inland waters, have long been a source of friction in international relations. Historically, the right of all nations to the high seas has been recognized. Several rules concerning jurisdiction over territorial seas have developed, the most common being the three mile 'cannon shot' rule. Difficulties in drawing the 'base line' for the delimitation of the territorial sea arise where states have rough, deeply indented coastlines, and in cases of islands or large bays or gulfs. The extent of jurisdiction over territorial waters has been historically conceived of as actual ownership, subject to the right to innocent passage of foreign vessels. Presently, the plethora of limits claimed by various nations causes much international dispute. Most nations claim three mile limits, but some claim four, twelve, and even two-hundred miles. Several international conferences have failed to solve the problem. Much legal and political turmoil could be avoided by an international agreement on some standard, such as a six mile limit with a six mile contiquous zone where the coastal state would have exclusive fishing and exploitation rights. (Caldwell-Florida)
W70-08814

THE CONSTITUTIONAL SANCTITY OF A PROPERTY INTEREST IN A RIPARIAN RIGHT.
Washington University Law Quarterly, Vol 1969, p 327-338.

Descriptors: *Riparian rights, *Permits, *Regulation, *Administrative agencies, Compensation, Prior appropriation, Control, Legal aspects, Legislation, Competing uses, Water utilization, Reasonable use, Water allocation (Policy), Water rights, Administration, Economics, Non-structural alternatives, Public benefits, Public rights, Usufructuary right, Water users.

As a water supply sufficiently abundant for all needs has disappeared in the Eastern United States, the justifications for the traditional riparian doctrine have also decreased. State legislation has been widely proposed to meet the increasing need for administrative supervision of all future water allocation. Much proposed legislation, based on the Model Water Use Act, changes the riparian system by the creation of a permit system. Existing uses of water would be allowed to continue, but future uses could only be instituted by obtaining a permit. Broad discretion would be accorded agencies in establishing priorities in the issuance of permits. The permits should be of a fixed duration sufficient to provide investment security. The agency would have power to issue a permit for water use without regard to common law restrictions on the riparian's use. Modifications of riparian uses in the nature of regulations should be permitted under the police power with no compensation required. If the modification amounted to a taking of property, compensation would be required to satisfy due process. The historical test, however, has required compensation for any diminution of value of a property right caused by government regulations. (Hubener-Florida)
W70-08815

NARAMORE V STATE (DAMAGES FOR NEGLIGENT OPERATION OF BARGE CANAL).
285 NY 80, 32 NE2d 800-802 (1941).

Descriptors: *New York, *Dams, *Damages, *New York State Barge Canal, Canals, Channels, Engineering structures, Ice, Melting, Sluices, Structures, Regulation, Surface waters, Damsites, Mill dams, Barriers, Judicial decisions, Legal aspects, State governments, Discharge (Water), Open channels.

Plaintiff land owner brought action against defendant state for damages allegedly arising from the negligent operation of a barge canal. Defendant had opened the sluice gates at two points on the canal and thereby raised the level of water in a creek which flowed across plaintiff's land. Plaintiff had constructed a dam on the creek for the operation of a flour mill. Ice had formed on the water in

the creek and around the abutments of the dam. Plaintiff claimed that the higher water level raised the ice against the dam, thereby causing it to topple over. Defendant claimed plaintiff was negligent in not cutting a channel in the ice as had been done in previous years, and that plaintiff had been on notice of the impending water release. The Court of Appeals of New York ruled that plaintiff could not have known the release would happen so early in the year and that the need for the channel only arose when a thaw threatened to raise the water level. The judgment of the trial court for the plaintiff was reinstated. (Barker-Florida)
W70-08822

PEOPLE V MCDONNELL (PROTECTION OF PUBLIC RIGHTS IN CANAL).
262 Ill 114, 199 NE 93-96 (1935).

Descriptors: *Illinois, *Navigable waters, *Canals, *Public rights, Inland waterways, Ownership of beds, Navigation, Transportation, Real property, Land use, Jurisdiction, State governments, Federal government, Legislation, Water pollution, Waste disposal, Developed waters, Watercourses (Legal), Judicial decisions, Legal aspects.

Plaintiff citizens, through the state attorney general, sought to enjoin defendant's encroachment upon the bed of a canal and his disposal of garbage and other refuse into the canal. Defendant claimed title to a tract of land along the canal. Defendant also asserted that: (1) little water remained in the canal; (2) the canal was filled in, in many places; and (3) the state had abandoned the canal by not using it for 35 years. Plaintiffs contended that defendant's activities were a public nuisance and constituted an encroachment upon state property. The court, in holding for plaintiffs, found that the canal had been constructed by the state under the authority of the federal government and was a navigable body of water. Although the canal was an artificial waterway which was at present unnavigable, the state retained the power to preserve the canal for future transportation. No federal or state act had been passed expressly abandoning the canal. The canal could not lose its status as a navigable waterbody without an express act of Congress. The state, by statute, was empowered to protect public rights in the canal. (Hubener-Florida)
W70-08836

BOSTON AND A RR V COMMONWEALTH (CONTRACT FOR LAND TO CREATE A RESERVOIR).
6 NE2d 613-618 (Mass 1937).

Descriptors: *Massachusetts, *Administrative agencies, *Claims (Contracts), *Supervisory control (Power), Reservoirs, Contracts, Water supply, Reservoir storage, River basin development, Railroads, Water districts, Flooding, Submergence, Dam construction, Damstes, Municipal water, Land tenure, Land use, State governments, Administrative costs, Administrative decisions, Judicial decisions, Legislation, Legal aspects.

Plaintiff railroad brought action against the Commonwealth of Massachusetts to recover damages from an alleged breach of contract. Plaintiff contracted with the Metropolitan District Water Supply Commission, which purported to act for the Commonwealth, for the abandonment of plaintiff's railroad running through the Swift River Valley, wherein a storage reservoir was to be created. The property of the plaintiff railroad was included in the area to be flooded by the reservoir and upon which a dam was to be erected. Plaintiff removed all railroad appurtenances, did all things required of it under the contract, and delivered a deed conveying the land to the Commission. The Commonwealth, however, declined to remit the amount specified in the contract. It contended that the Commission was not authorized by statute to make any such binding contract without the approval of the Governor and Council, which approval was not obtained. The court, interpreting the applicable statutes, held that the Commission had sufficient authority to make contracts for the securing of additional water supply for the metropolitan water system and could bind the Commonwealth even without approval by the Governor and Council. (Dearing-Florida)
W70-08857

INSTITUTIONS FOR EFFECTIVE MANAGEMENT OF THE ENVIRONMENT.
National Academy of Sciences-National Academy of Engineering, Washington, D.C. Environmental Studies Board.

Washington, D.C., National Academy of Sciences - National Academy of Engineering, January 1970. 62 p.

Descriptors: *Environment, *Institutions, *Management, Environmental effects, Institutional constraints, Organizations, Administration, Planning.
Identifiers: *Environmental policy.

It is concluded that present institutional arrangements for effective environmental management are inadequate. A much greater emphasis on environmental monitoring is essential, as is the development of an Environmental Quality Index as a management tool, the establishment of a Board of Environmental Affairs within the Office of the President and a National Laboratory for Environmental Science. There is a need for continuing systematic analysis in support of efforts to deal with the environment and the national policies affecting the environment, and a new Institute for Environmental studies has been proposed to meet this need. (Davis-Chicago)
W70-08929

WATER QUALITY CONTROL IN CALIFORNIA,
California State Water Resources Control Board, Sacramento.
For primary bibliographic entry see Field 05G.
W70-08943

RESPONSIBILITY IN WEATHER MODIFICATION OPERATION,
Fresno State Coll. Foundation, Calif. Atmospheric Water Resources Research; and South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences.
For primary bibliographic entry see Field 03B.
W70-08951

RECOVERY OF POLLUTED WATER,
Ontario Water Resources Commission, Toronto. Great Lakes Water Quality Surveys Program.
For primary bibliographic entry see Field 05G.
W70-08988

IS WATER DIFFERENT,
Department of Energy, Mines and Resources, Ottawa (Ontario). Policy and Planning Branch.
For primary bibliographic entry see Field 06C.
W70-08997

ONTARIO CONSERVATION AUTHORITIES--AN ADMINISTRATIVE APPROACH TO RESOURCES MANAGEMENT,
Metropolitan Toronto and Region Conservation Authority, Woodbridge (Ontario).
K. G. Higgs.
In: Proceedings of Symposium on Water Balance in North America, June 23-26, 1969, Banff, Alberta, Canada, American Water Resources Association, Urbana, Illinois, p 261-265, 1969.

Descriptors: *Water law, *Water conservation, *Flood control, *Watershed management, Forest management, Water resources development, River basin development, Water management (Applied).
Identifiers: Ontario, Canada.

The Conservation Authorities Act of Ontario is so constituted that the watershed becomes the natural physiographic and hydrologic unit on which to base a rational program of flood control and water conservation. Provision is made in the Act for the management of all of the natural resources of the watershed and Authorities to carry out programs in forest management, fish and wildlife management and soil conservation. The Act also makes provision for Authorities to use and develop its lands acquired for conservation projects, for outdoor recreation and educational purposes. (See also W70-08597)
W70-08998

WATER SUPPLY AUGMENTATION BY REUSE,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 05D.
W70-08999

6G. Ecologic Impact of Water Development

ENVIRONMENTAL IMPACT OF THE BIG CYPRESS SWAMP JETPORT.
Department of the Interior, Washington, D.C.
For primary bibliographic entry see Field 04C.
W70-08596

WASTE WATER DISPOSAL ENHANCES AN AREA ECOLOGY,
Campbell Soup Co., Napoleon, Ohio.
For primary bibliographic entry see Field 05D.
W70-08850

07. RESOURCES DATA

7A. Network Design

HYDROMETRIC SURVEYS,
Shawinigan Engineering Co. Ltd., Montreal (Quebec).
For primary bibliographic entry see Field 02E.
W70-08606

INSTRUMENTATION IN WATER QUALITY MONITORING AND SAMPLING,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 05A.
W70-08616

HYDROMETEOROLOGICAL AUTOMATIC TELEMETERING STATIONS,
Meteorological Service of Canada, Toronto (Ontario).
For primary bibliographic entry see Field 02B.
W70-08618

7B. Data Acquisition

EMISSION BY UNDERWATER EXPLOSIONS,
French Inst. of Petroleum, Paris.
M. Lavergne.
Geophysics, Vol 35, No 3, p 419-435, June 1970. 17 p, 20 fig, 3 tab, 26 ref.

Descriptors: *Sounding, *Seismic studies, *Explosives, *Explosions, *Surveys, *Seismic properties, Bottom sediments, Sound waves, Instrumentation, Acoustics, Geophysics, Hydrography.
Identifiers: Underwater explosions, Seismic exploration.

Theoretical and experimental investigations of the seismic effects of underwater explosions of dynamite charges are described. Acoustic efficien-

cy was determined in a broad frequency band. In the seismic frequency band, the partition of energy between the shock wave and bubble pulses, the seismic effects of cavitation due to ghost reflection at the air-water interface, and the damage caused to marine life were determined. The seismic efficiency of charges of the order of 100 gm can be considerably increased by dividing the charges and by shooting at depth. Two or three properly spaced 50 gm charges of dynamite, shot at a depth of about 12 m, give the same result as a single charge of about 5 to 15 kg shot at a depth of 1 m. Marine sections comparing caged charge shooting with conventional shooting in the same area are shown. (Knapp-USGS)
W70-08585

NEW TECHNIQUES IN THE SEARCH FOR WATER IN LIMESTONE,
Auburn Univ., Alabama. Water Resources Research Inst.; and Alabama State Geological Survey, University.
For primary bibliographic entry see Field 02F.
W70-08609

DECODING AERIAL PHOTOGRAPHS OF GLACIAL LANDSCAPES - INDICATORS OF GROUNDWATERS,
G. Ya. Meyer, and V. K. Markovskiy.
Transl for FSTC by Techtran Corp. Available from Clearinghouse as AD-696 181, $3.00 in paper copy, $0.65 in microfiche. Original source-Akad Nauk, SSSR, Laboratoria Aerometodov Primenenie Aerometodov Dlia Izucheniia Gruntovykh VOD, p 69-79, 1962. US Army Foreign Science and Technology Center, Technical Translation Report FSTC-HT-23-398-68, October 7, 1969. 27 p, 8 fig, 10 ref. Project No 02RD500-2301.

Descriptors: *Aerial photography, *Water resources development, *Glacial drift, *Terrain analysis, Geomorphology, Photogrammetry, Surveys, Mapping, Glaciation.
Identifiers: Aerial photography interpretation.

Characteristics of landscape indicators of groundwaters are described for photointerpretation. Four glacial types of landscape, including hilly-moraine, drumlin, morainic plain and terminal-moraine; three water-glacial types of landscape, including kame (and os), lake-glacial plain and outwash plain; the karst erosion type of landscape; and seashores are described. Interpretation of water-related features of these types of terrain on aerial photographs is discussed. (Knapp-USGS)
W70-08610

INSTRUMENTATION AND OBSERVATION TECHNIQUES.

Proceedings of Canadian Hydrology Symposium No 7, Victoria, British Columbia, scheduled for May 14-15, 1969; held Oct 8-9, 1969, National Research Council of Canada, Subcommittee on Hydrology, 2 Vol, 1969. 343 p.

Descriptors: *Conferences, *Instrumentation, *Remote sensing, *Hydrologic data, Mapping, Data collections, Surveys, Water levels, Meteorology, Water resources, Hydrogeology, Geophysics, Telemetry, Data processing, Data transmission, Data storage and retrieval, Soil moisture, Groundwater, Surface waters, Climatology.
Identifiers: Canada.

The primary purpose of the Seventh Canadian Hydrology Symposium was to provide Canadian hydrologists with a reference work of not only traditional instruments and techniques but also a reference relative to those instruments and techniques now in the experimental and development stage. A second objective, as in previous symposia, was to stimulate an information exchange and in this regard most of the program time was alloted to discussion. The program included 15 original papers allocated to two sessions. The first session was devoted to instrumentation with emphasis on meteorological, soil moisture, groundwater, surface water, sedimentation and water quality instruments, and the second session concentrated on new techniques. Included in this latter category was a paper on tracers and two panels with papers related to automatic stations and remote sensing techniques. (Knapp-USGS)
W70-08611

REVIEW HYDROMETEOROLOGICAL INSTRUMENTATION,
Department of Transport, Toronto (Ontario). Meteorological Branch.
D. J. McKay.
Proceedings of Canadian Hydrology Symposium No 7, Victoria, British Columbia, scheduled for May 14-15, 1969; held Oct 8-9, 1969, National Research Council of Canada, Subcommittee on Hydrology, p 1-20, Vol 1, 1969. 20 p, 17 ref.

Descriptors: *Instrumentation, *Data collections, *Hydrologic data, Precipitation gages, Rain gages, Precipitation (Atmospheric), Telemetry, Snow surveys, Nuclear moisture meters, Air temperature, Winds, Solar radiation, Sampling, Humidity, Data processing.
Identifiers: Hydrometerological instrumentation, Canada.

Instrumentation designed to measure precipitation, temperature, and evaporation, are thoroughly reviewed and other meteorological instruments required in Canadian hydrological research and operations are discussed. Precipitation gages measure rain or snow, or both liquid and solid precipitation. These instruments range from standard basic equipment to sophisticated long-duration recording devices with analog, digital, or telemetry output. Precipitation gages shields are described and the section on snow gages includes a discussion of snow samplers, snow pillows and radioactive measuring techniques. Evaporation instrumentation includes pans, atmometers, and lysimeters. Measurements of meteorological parameters used in evaporation equations, such as air and water temperatures, wind, humidity and solar radiation are described. (Knapp-USGS)
W70-08612

SOIL MOISTURE,
Department of Agriculture, Ottawa (Ontario). Soil Research Inst.
For primary bibliographic entry see Field 02G.
W70-08613

GROUNDWATER INSTRUMENTATION AND OBSERVATION TECHNIQUES,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 02F.
W70-08614

SURFACE WATER,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 02E.
W70-08615

AUTOMATIC CLIMATOLOGICAL RECORDING STATIONS IN REMOTE AREAS,
McGill Univ., Montreal (Quebec).
For primary bibliographic entry see Field 02B.
W70-08617

REMOTE SENSING GEOPHYSICAL APPLICATIONS TO HYDROLOGY,
Geological Survey of Canada, Electrical Methods Section.
For primary bibliographic entry see Field 02F.
W70-08619

AUTOMATIC HYDROLOGICAL DATA COLLECTING STATIONS,
Department of Energy, Mines and Resources, Ottawa (Ontario). Marine Sciences Branch.
G. C. Dohler.
Proceedings of Canadian Hydrology Symposium No 7, Victoria, British Columbia, scheduled for May 14-15, 1969; held Oct 8-9, 1969, National Research Council of Canada, Subcommittee on Hydrology, p 219-235, Vol 1, 1969. 17 p, 4 fig, 3 ref.

Descriptors: *Telemetry, *Data collections, *Data transmission, *Hydrologic data, Tides, Water level fluctuations, Water levels, Navigation, Data processing, Data storage and retrieval, Logging (Recording).
Identifiers: Canada.

Several automatic tide and water level recording systems for observations over long periods, for telemetry using permanently rented telephone lines, for interrogation by a simple telephone call and by radio carrier technique, used for several years by the Tides and Water Levels Section of the Department of Energy, Mines and Resources, Canada, are described. In the Canadian Arctic, or in areas with long-sloping foreshores, or for water level measurements at the continental shelf, pressureoperated devices were developed, utilizing as much as possible, commercially available components. Automatic analogue recording devices were modified to make the data output compatible for computer usage. Digital recorders are being installed on a trial basis at tide and water level stations to improve the data gathering and processing procedures. (Knapp-USGS)
W70-08620

APPLICATIONS OF SATELLITE PHOTOGRAPHS TO HYDROLOGY IN CANADA,
Department of Transport, Toronto (Ontario). Meteorological Branch.
For primary bibliographic entry see Field 02B.
W70-08622

REMOTE SENSING BY INFRA-RED TECHNIQUES,
Department of Transport, Toronto (Ontario). Meteorological Branch.
T. L. Richards.
Proceedings of Canadian Hydrology Symposium No 7, Victoria, British Columbia, scheduled for May 14-15, 1969; held Oct 8-9, 1969, National Research Council of Canada, Subcommittee on Hydrology, p 295-309, Vol 1, 1969. 15 p, 6 fig, 9 ref.

Descriptors: *Remote sensing, *Infrared radiation, *Radar, Temperature, Instrumentation, Water temperature, Spectroscopy, Mapping.
Identifiers: Microwave radiometry, Canada.

The Airborne Radiation Thermometer provides a fast, relatively accurate and operationally-proven technique for measuring surface water temperatures of large bodies of water. The basic theory of the infrared bolometer, some of the instrumentation currently available, operational problems and their solutions and a method for correcting for the environmental error introduced by the atmosphere are discussed. A test and evaluation study of a relatively inexpensive analog system is reviewed and followed by a description of highly successful operational surveys which are still being conducted. A more sophisticated, and more expensive, infra-red scanner which provides detailed imagery of the surface water temperature patterns and newer microwave techniques are also reviewed and their relative merits discussed. (Knapp-USGS)
W70-08623

TRACER TECHNIQUES IN HYDROLOGY,
Guelph Univ. (Ontario). Dept. of Soil Science.
D. E. Elrick, and D. W. Lawson.
Proceedings of Canadian Hydrology Symposium No 7, Victoria, British Columbia, scheduled for

May 14-15, 1969; held Oct 8-9, 1969, National Research Council of Canada, Subcommittee on Hydrology, p 155-187, Vol 1, 1969. 33 p, 1 fig, 2 tab, 119 ref.

Descriptors: *Tracers, *Tracking techniques, *Hydrogeology, Groundwater movement, Soil water movement, Sediments, Sediment transport, Precipitation (Atmospheric), Streamflow, Radioactivity techniques, Dye releases, Dispersion, Mixing, Diffusion, Porous media, Surface waters, Groundwater, Soil water, Instrumentation.
Identifiers: Canada.

Knowledge of water movement in many areas of the hydrological cycle can be aided by the use of tracer techniques. The present state of tracer technology, both radioactive and non-radioactive is reviewed and applications to the transport of water in the atmosphere throughout all areas of the hydrological cycle are discussed. The prerequisites of a good tracer in the atmosphere, soil, rivers, or groundwater are described and the performance of tracers such as tritium, colored dyes, and others is discussed with reference to particular applications. Measurement techniques are emphasized. (Knapp-USGS)
W70-08624

RADAR AS A REMOTE SENSOR FOR HYDROLOGY,
McGill Univ., Montreal (Quebec). Dept. of Physics.
For primary bibliographic entry see Field 02B.
W70-08625

INSTRUMENTATION AND TECHNIQUES IN SEDIMENT SURVEYING,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 02J.
W70-08626

PROJECT CALORIC - AN INVESTIGATION OF HEAT RELEASE PATTERNS ASSOCIATED WITH PRESENT AND PLANNED ELECTRIC POWER PLANTS ON CAYUGA LAKE (Experimental Program),
Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
G. Neumaier, and D. Bock.
Cornell Aeronautical Laboratory, Inc., Final report, Nov., 1969. 61 p, 30 fig, 2 tab, 5 ref.

Descriptors: *Isotherms, *Thermocline, *Data collections, *On-site data collection, *Infrared radiation, *Remote sensing, Electric power plants, Nuclear power plants, Instrumentation, Bouyoucos blocks, Thermometer, Current meter, Digital computer, Telemetry, Computer program.

Experimental results are presented of the 12-month investigation of the heat release patterns associated with the present and planned electric power plants of Cayuga Lake. A detailed description is given of the measuring instrumentation and techniques that were used to obtain the data. The information is presented in two sections: The first, 'Aerial Infrared Measurements, describes the aerial measurement effort and presents the plots of isotherms in the lake. The second 'In-Lake Measurements,' describes the design and utilization of the in-lake instrumentation and presents typical examples of the lake data. (Osborne-Vanderbilt)
W70-08827

AUTOMATIC MASS SPECTROMETRIC ANALYSIS OF THE DEUTERIUM TO HYDROGEN RATIO IN NATURAL WATER,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chemistry and Materials Div.
W. M. Thurston.
The Review of Scientific Instruments, Vol 41, No 7, p 963-966, July 1970. 6 fig, 5 ref.

Descriptors: *Deuterium, *Spectrometers, *Chemical analysis, *Automation, Instrumentation, Water analysis, Stable isotopes, Sampling, Analytical techniques.
Identifiers: *Automatic mass spectrometry, *Mass spectrometers.

A sampling concept to convert liquid water to vapor, without changes in the deuterium to hydrogen ratio, makes possible the construction of an automated mass spectrometer system for determining the deuterium to hydrogen ratio of water samples. The automatic cycle uses an increasing pressure approach to mass spectrometer dosing with excellent suppression of memory effects. Mass-2 ion abundance is used as the pressure sensor to actuate the single control valve in the automatic cycle, coupled with digital readout of the mass-3 ion abundance. A precision of 0.1 ppm at the natural concentration level is achieved with a cycle time of 2 min. The automatic cycle may be applied to on-stream gaseous hydrogen analysis with a precision of 0.1 ppm and a 50 sec cycle time. (Knapp-USGS)
W70-08937

A THREE COMPONENT DRAG PROBE FOR THE MEASUREMENT OF TURBULENT WATER VELOCITY FLUCTUATIONS,
Oregon State Univ., Corvallis. Dept. of Oceanography.
Marshall D. Earle, Jack H. Groelle, and George F. Beardsley, Jr.
The Review of Scientific Instruments, Vol 41, No 7, p 1021-1025, July 1970. 6 fig, 11 ref. Grant GA 998 (NSF).

Descriptors: *Turbulence, *Flowmeters, *Turbulent flow, Velocity, Current meters, Flow, Open channel flow, Instrumentation, Friction, Frequency, Fluid friction.
Identifiers: Turbulence meters, Drag probes.

Two spherical drag probes which use variable inductance devices as displacement transducers were built to measure turbulent water velocity fluctuations. The associated circuitry provides voltage outputs which are proportional to the three components of force acting on the spherical sensor of each probe. The probes respond to the fluid drag force and also to the fluid inertial force in an accelerating flow field. The frequency at which the response is 3dB down is 18 Hz for one probe and 41 Hz for the other. The instruments have been calibrated for oscillating flows with velocities from 10 to 150 cm/sec. (Knapp-USGS)
W70-08938

PRACTICAL METHODS FOR DETERMINING SEWAGE FLOW FOR ALL COMMUNITIES,
Metropolitan Corp. of Greater Winnipeg (Manitoba).
For primary bibliographic entry see Field 05D.
W70-08963

7C. Evaluation, Processing and Publication

AREAL EXTENSION OF STREAMFLOW INFORMATION BY MULTIPLE-REGRESSION TECHNIQUES,
Geological Survey, Washington, D.C. Surface Water Branch.
For primary bibliographic entry see Field 02E.
W70-08607

GLACIER DISCHARGE SIMULATION,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 02C.
W70-08608

PHOTOGRAPHIC REMOTE SENSING FOR HYDROLOGY,
Guelph Univ. (Ontario).
Stanley H. Collins.
Proceedings of Canadian Hydrology Symposium No 7, Victoria, British Columbia, scheduled for May 14-15, 1969; held Oct 8-9, 1969, National Research Council of Canada, Subcommittee on Hydrology, p 283-294, Vol 1, 1969. 12 p, 1 fig, 1 ref.

Descriptors: *Aerial photography, *Remote sensing, *Hydrologic data, *Mapping, Data storage and retrieval, Photogrammetry, Water resource development, Rainfall-runoff relationships, Snow surveys, Infiltration, Water yield, Runoff, Streamflow, Flood damage, Evapotranspiration, Precipitation (Atmospheric).
Identifiers: Canada.

The uses of aerial photography in hydrology are reviewed briefly. Photography is discussed in its relationships with other remote sensing techniques and the reasons are given why the photographic techniques of recording, storage and mapping are valuable and why their uses are multiplying. An account is given of the development of new photographic mapping techniques, including a description of the production and properties of orthophotos. Brief mention is made of the new stereorthophotos and their advantages for resource development planning. (Knapp-USGS)
W70-08621

WATER INVENTORY STUDIES IN THE UNITED STATES AND THE I.H.D. PROGRAM,
National Committee for the International Hydrological Decade, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-09001

CANADIAN RESEARCH,
National Committee for the International Hydrological Decade, Ottawa (Ontario).
For primary bibliographic entry see Field 02E.
W70-09002

08. ENGINEERING WORKS

8A. Structures

GATES AND RELATED OPERATING EQUIPMENT,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
N. H. Latimer, and J. Pocher.
Engineering Journal-Canada, Vol 52, No 10, p 99-108, Oct 1969. 10 p, 10 fig, 4 ref.

Descriptors: *Hydraulic gates, Gate hoists, Intake gates, *Fixed wheel gates, Design, *Radial gates, Spillway gates, Corrosion, Paints, Foreign design practices, Corrosion control, Painting, Protective coatings, Gate seals, *Slide gates, *Handling equipment, Design criteria, Model tests, Hydraulic systems.
Identifiers: Peace River Proj (Canada), Canada, Portage Mountain Dam (Canada).

The design and operating characteristics of the gates and gate operating equipment used on the Portage Mountain Development in Canada are reviewed. The gates described include 13 ft-0 in. wide by 19 ft-6 in. high fixed-wheel intake gates designed for 265-ft head and operated by submerged linear hydraulic actuators, 15 ft-0 in. wide by 32 ft-10 in. high horizontally split draft tube gates, 50 ft-0 in. wide by 62 ft-0 in. high spillway radial gates, and 6 ft-0 in. wide by 8 ft-0 in. high free-discharge spillway slide gates. Material selection and design details of some important elements are outlined and operating experiences are reported on gates in service. Some conclusions are: (1) protection against corrosion is important in

gate design; (2) weight of paint should be taken into account when determining hoisting effort, especially for large radial gates such as those used on the Portage Mountain Development where the weight of paint on each gate approached 10,000 lb; and (3) problems and innovations in gate construction should be reported in literature to aid designers. (USBR)
W70-08684

SEMI-CIRCULAR STOPLOGS,
International Power and Engineering Consultants Ltd, Vancouver (British Columbia).
J. J. Sled, and N. Purssell.
Engineering Journal - Canada, Vol 52, No 10, p. 117-124, Oct 1969. 8 p, 8 fig, 3 ref.

Descriptors: *Stop logs, Hydraulic gates, *Handling equipment, Cranes, Design, Construction, Diversion tunnels, Operation and maintenance, Cold weather construction, Model tests, Spillway gates, Installation, Foreign projects, Freezing, *Semicircular sections, River closures, Diversion.
Identifiers: *Closures, *Lifting devices, Peace River Proj, Can; Canada, Icing, Low temperature.

A description is given of the design, construction, and operation of 53-ft-dia semicircular stoplogs used for closing the 48-ft-dia diversion tunnels at the W A C Bennett Dam, Peace River Project, Canada. Handling equipmetnt consists of a specially designed lifting beam capable of automatically engaging and releasing the stoplogs, and a gantry crane for picking up stoplogs from a storage area and placing them in the entrance of any one of the 3 diversion tunnels. Handling equipment and stoplogs are designed for placing during low temperature conditions and at flows of 45,000 cfs through the tunnel that is being closed. The stoplogs are designed for a static head of 141 ft. Semicircular stoplogs were developed and have been used extensively in Sweden, but this use is believed to be the first on a major project in North America. Following completion of the final tunnel plug, the stoplogs and gantry crane were moved to the spillway area where the same system will provide upstream closure of the spillway channel and permit maintenance of the spillway radial control gates. (USBR)
W70-08686

HASKELL V STATE (LIABILITY FOR DAMAGES CAUSED BY INADEQUATE DAM DESIGN).
For primary bibliographic entry see Field 06E.
W70-08772

NORTHERN NEW YORK POWER CORP V STATE (CLAIMS ARISING FROM DAM CONSTRUCTION WHICH NECESSITATED REBUILDING OF A POWERPLANT).
For primary bibliographic entry see Field 06E.
W70-08777

BONDY V UTAH CONSTR CO (TUNNEL CONSTRUCTION INTERFERING WITH UNDERGROUND STREAMFLOW).
For primary bibliographic entry see Field 06E.
W70-08792

COOLING TOWERS GET BIGGER AND BETTER AS WATER DEMANDS GROW.
For primary bibliographic entry see Field 05D.
W70-08830

USES OF WASTE HEAT,
Oak Ridge National Lab., Tenn.
For primary bibliographic entry see Field 05G.
W70-08832

8B. Hydraulics

BOUNDARY LAYER EFFECT ON THE COURSE OF THE SELF-PURIFICATION OF SMALL STREAMS,
Hydraulic Research Inst., Brno (Czechoslovakia).
For primary bibliographic entry see Field 05G.
W70-08631

STILLING BASINS WITH WEDGE-SHAPED BAFFLE BLOCKS,
N. Narayana Pillai.
Water and Water Engineering, Vol 73, No 886, p 506-509, Dec 1969. 4 p, 7 fig, 5 ref.

Descriptors: *Stilling basins, Energy dissipation, *Baffles, Hydraulic models, Scour, Shape, Wedges, Hydraulics, Model studies, Hydraulic jump, Froude number, Cavitation, Foreign research.
Identifiers: *Chute blocks, *Baffle piers, Bureau of Reclamation, Bed profiles, India.

Hydraulic model studies were conducted in India to determine the suitability of wedge-shaped baffle blocks in stilling basins. Performance of the wedge-shaped baffle blocks was compared with that of rectangular baffle blocks used by the Bureau of Reclamation in the study of its Stilling Basin III model. The wedge-shaped baffle blocks can be placed farther up the jump than rectangular blocks, increasing the drag and energy dissipation considerably. Stilling basins using the wedge-shaped blocks can be developed to operate efficiently and are shorter in length. Because of the super-cavitating shape of the baffle blocks, susceptibility to cavitation is less. More detailed experiments are necessary to finalize the dimensions of the basins. (USBR)
W70-08676

LOW LEVEL OUTLETS,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
W. C. Goines, and E. A. Portfors.
Engineering Journal-Canada, Vol 52, No 10, p 71-75, Oct 1969. 5 p, 6 fig, 2 ref.

Descriptors: Outlets, *Outlet works, Valves, Foreign design practices, Foreign construction, *Energy dissipation, *High pressure valves, *Model tests, *High pressure gates, Hydraulic models, Model studies, Hydraulic design, Performance, Hydraulic gates and valves, Steel linings.
Identifiers: Outlet tunnels, *Hollow cone valves, Deflectors, Canada, Valve vibration, Energy dissipators, W A C Bennett Dam, Canada.

The design and operation of the low level outlets at W A C Bennett Dam in Canada are described. The outlets consist of twin 84-in.-dia hollow cone valves installed in the concrete plugs in 2 of the 3 diversion tunnels. Each hollow cone valve is backed up by two 84-in. ring follower gates designed to close under maximum head and full discharge. Hollow cone valves were selected for the outlets because of the design requirement for high energy dissipation within a relatively short portion of the tunnels for a wide range of flow conditions. The energy dissipation chambers immediately downstream from the concrete plugs consist of 43-ft-dia circular barrel sections incorporating deflector rings that project 4.5 ft inward from the barrel walls. The chambers are steel lined around the full circumference for a distance of 63 ft downstream from the plug and around the lower half for an additional 71 ft. Hydraulic model studies for determining the energy dissipation capability are described and results given. Hydroelastic model tests were run to ascertain response of the hollow cone valve components to flow-induced vibrations. (USBR)
W70-08677

SPILLWAY--PART I AND PART II,
Western Canada Hydraulic Labs. Ltd; and International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
J. W. Ball, P. E. Fawkes, and R. E. Johnson.
Engineering Journal-Canada, Vol 52, No 10, p 76-87, Oct 1969. 12 p, 15 fig, 3 ref, append.

Descriptors: Flood routing, *Spillways, Radial gates, Sluices, Foreign design practices, *Flip buckets, *Model tests, Model studies, *Hydraulic models, Chutes, Transitions (Structures), Hydraulic structures, Pressure distribution, Energy dissipation, Control structures, Groins, Tailwater, Scour, Surges.
Identifiers: *Ski-jump spillways, Spillway piers, Ogee crests, Canada, Chute spillways, Approach channels, W A C Bennett Dam, Canada.

The spillway at W A C Bennett Dam in Canada is one of the largest ski-jump-type spillways in the world. The spillway has a drop of 550 ft and is designed for a maximum discharge of 341,000 cfs. Main elements of the spillway are: an approach channel, three 50-ft-wide ogee sections containing 9 sluices and controlled by three 62-ft-high radial gates, a transition section, a discharge channel, and a steep chute that terminates in a flip bucket. Two papers describe tests of 2 hydraulic models. The inlet model was at a 1:84 scale and included a portion of the dam and reservoir, the approach channel, control structure, transition, and discharge channel. The outfall model was at a 1:96 scale and included the discharge channel, chute, flip bucket, and river tailrace area. Modifications to the approach channel, piers, and transition section resulting directly from the inlet model tests are described. Out-fall model tests resulted in a lower elevation, an increase in the lip angle, and an asymmetrical bowl-shape for the flip bucket. (USBR)
W70-08683

8C. Hydraulic Machinery

PEACE TRANSMISSION LINES, 500KV--DESIGN AND CONSTRUCTION,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
J. C. Stevens, and W. P. Johnson.
Engineering Journal-Canada, Vol 52, No 10, p 131-135, Oct 1969. 5 p, 2 fig, 2 tab, 2 ref.

Descriptors: *Transmission lines, *Extra high voltage, Dampers, *Extra long distance, Transmission towers, Guyed towers, Construction, Spacers, Electrical design, Electric insulation, Clearances, Construction costs, Helicopters, Bundled conductors, Electrical insulators, Foreign construction.
Identifiers: *Peace River Proj (Canada), Grille footings, Transmission line hardware, Electric conductors, Suspension insulators, Canada.

Design and construction features of the two 500-kv transmission lines from the Peace River Project in northeastern British Columbia are described. The 2 ehv lines will be capable of carrying the ultimate output of the Gordon M Shrum Generating Station to Southern Canadian power centers. The 576-mile line was energized at 500-kv during 1968. The 548-mile line was put into service as far as Kelly Lake Substation in 1969, with the remaining section under construction. Line parameters, tower and foundation design, conductor hardware, conductors, insulation and clearances, and construction are discussed. The use of guyed towers resulted in appreciable savings compared to all-rigid tower construction. Many miles of the line have been completed for 2 or 3 winters, and the service record is excellent. (USBR)
W70-08672

DC CIRCUITRY IN POWER SYSTEMS PROTECTION,
Northeast Utilities Service Co., Wethersfield, Conn.
T. U. Patel, and N. M. Reid.

Transmission and Distribution, Vol 22, No 4, p 60-63, Apr 1970. 4 p, 3 fig.

Descriptors: *Power system operations, *Reliability, Direct current, *Electric relays, *Faults (Electrical), Supervisory control (Power), Batteries, Fuses (Electrical), Power operation and maintenance, Electric wires, Electrolysis.
Identifiers: *Protection (Electrical), Electric conductors, Power system stability.

Power system protection requires reliability, high speed, stability, and sensitivity. To achieve this, equipment associated with protective schemes must function correctly. Direct-current circuitry performs a major function of the scheme, and care must be exercised in the design, selection, and maintenance of the protective equipment. The protective equipment may be used to isolate a fault only once, so there should be no risk of failure of the d-c circuitry. (USBR)
W70-08682

CONSTRUCTION PLANNING OF THE UNDERGROUND POWERPLANT,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
For primary bibliographic entry see Field 06B.
W70-08687

WORLD'S LARGEST HYPERBOLIC TOWER COOLS A POWER PLANT.
For primary bibliographic entry see Field 05D.
W70-08837

8D. Soil Mechanics

THE COLUMBIA RIVER DEVELOPMENT--A GEOTECHNICAL REVIEW,
British Columbia Hydro and Power Authority, Vancouver; and Thurber (R. C.) and Associates Ltd., Victoria (British Columbia).
R. C. McMordie, and G. C. Morgan.
Engineering Journal: Canada, Vol 53, No 2, p 9-17, 30, Feb 1970. 10 p, 11 fig, 1 tab, 8 ref, disc.

Descriptors: *Earth dams, *Dam design, *Dam construction, Differential settlement, Dam foundations, Dams, Foreign construction, Cracking, Zoned embankments, Foreign design practices, Dewatering, Cutoff trenches, Soil liquefaction, Underseepage, Underwater construction, Cutoff walls, Impervious blankets, Settlement (Structural), Flexible foundations.
Identifiers: *Columbia River Development, Canada, Dam stability, Canada, Seepage control, Slurry trenches, Embankment subsidence.

The current phase of the Columbia River Development in British Columbia consists of constructing 3 earthfill dams: Duncan, Hugh Keenleyside, and Mica. Some problems in design and construction of the dams and steps taken to cope with the problems are discussed. Problems at Duncan Dam were high foundation seepage and settlement and the possibility of foundation liquefaction. Hugh Keenleyside Dam has a deep, pervious foundation, and the site posed difficult dewatering problems. Problems at Mica Dam stemmed mainly from lack of precedent, particularly the behavior of earth and rockfill materials under high pressures. Control of embankment cracking was an important consideration for all 3 dams. Problems at Duncan were overcome by a reservoir blanket, a partial cut-off constructed by the slurry trench method, relief wells, flat embankment slopes, and control of the rate of embankment construction. At Hugh Keenleyside, a reservoir blanket was used to control seepage, and the need for dewatering was eliminated by constructing that portion of the dam below normal low water by controlled dumping of fill in the river. The approach used to overcome embankment cracking problems was to limit deformation of the fill as much as practicable and to provide in the design for development of cracks. (USBR)
W70-08670

LAND-SURFACE TILTING NEAR WHEELER RIDGE, SOUTHERN SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 08E.
W70-08953

8E. Rock Mechanics and Geology

YIELDABLE ROCK BOLTS FOR SHOCK LOADING AND GROUTED BOLTS FOR FASTER ROCK STABILIZATION,
East Rand Proprietary Mines Ltd., Boksburg (South Africa); and Colorado School of Mines, Golden.
W. D. Ortlepp, and John J. Reed.
Mines Magazine, Vol 60, No 3, p 12-17, Mar 1970. 5 p, 8 fig, 5 ref.

Descriptors: *Rock bolts, *Rock mechanics, *Rock excavation, Grouting, Tunnel design, Stabilization, Tunnels, Roof bolts, Tunneling, Foreign design practices, Underground structures.
Identifiers: *Rockbursts, Tunnel supports, Rock dilation, Underground openings, Yielding, South Africa, Rock pressures, Stress waves.

Yieldable rock bolts are effective in reinforcing underground openings against shock loading; fully grouted rock bolts have been very effective for reinforcement against static loading, especially when immediately installed and grouted. Analysis of support requirements shows that the inherent strength of a fractured rock wall tends to provide stability if the fractured rock is held in position and kept intact, even with relatively large displacements in the fractured shell. Design requirements for rock bolts are simple: the support must act quickly and maintain the restraining effect while yielding through appreciable displacements. Rock bolts are capable of supplying the early restraint, but have a limited yield capacity and may fail abruptly at high strain velocities. A yieldable rock bolt was developed and tested for resistance to blasting loads of the same order of magnitude experienced during rock bursts. Results indicate that a tunnel supported by yieldable rock bolts could survive all but the most violent rock bursts. An analysis comparing grouted with ungrouted rock bolts indicates a fully grouted rock bolt installed immediately after rock excavation, even though initially untensioned, should be several times more effective than a tensioned but ungrouted rock bolt. (USBR)
W70-08671

LAND-SURFACE TILTING NEAR WHEELER RIDGE, SOUTHERN SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Washington, D.C.
Francis S. Riley.
For sale by Superintendent of Documents, U S Government Printing Office, Wash, D C, 20402 - Price $0.70. U S Geological Survey Professional Paper 497-G, P G1-G29, 1970. 29 p, 16 fig, 1 plate, 12 ref.

Descriptors: *Subsidence, *Withdrawal, *Aquifers, *California, Water levels, Compaction, Geology, Soil mechanics, Hydrograph analysis, Observation wells, Water utilization.
Identifiers: San Joaquin Valley (Calif), Tiltmeters.

Two continuous-recording liquid-level tiltmeters and three associated borehole extensometers recorded tilt at land surface and compaction in the upper 150 feet of alluvial-fan deposits at the site of the future Wheeler Ridge pumping plant of the California Aqueduct. The location, at the southern end of the San Joaquin Valley, borders on a large bowl of active land subsidence caused by compaction of the confined aquifer system under the stress of artesian-head decline. It is in an area subject also to subsidence due to near-surface hydrocompaction of moisture-deficient fan deposits. It is also an area of potential tectonic movement related to the historically active White Wolf fault. Significant susceptibility to hydrocompaction existed at depth greater than 150 feet. A special array of 24 bench marks installed within a radius of 2,400 feet from the pumping-plant site was leveled six times between August 1965 and September 1966. The areal pattern of tilting determined by the leveling agreed with the tiltmeter data in defining two principal periods of northward tilting per year; these periods coincided with the winter and summer irrigation seasons. In 1966 the total northward tilt was 42 microradians. (Knapp-USGS)
W70-08953

8G. Materials

USES OF METALS IN OFFSHORE STRUCTURES,
Texas A and M Univ., College Station.
L. Dale Webb.
Oceanology International, Vol 5, No 3, p 19-23, Mar 1970. 5 p, 2 fig, 3 tab.

Descriptors: *Metals, Metal coatings, *Corrosion, Fatigue (Mechanics), Chemical degradation, Corrosion control, Brittle failures, Structures, Aquatic environment, *Materials engineering, Structural design, Oceans, Materials stability, Cathodic protection, Pitting (Corrosion).
Identifiers: *Offshore structures, Electrochemical corrosion, Hydrogen embrittlement, Undersea aqueduct (Collective), Stress corrosion.

Materials for offshore structures must withstand design loads and survive the environment for necessary service life with minimal maintenance. Ordinary parameters of strength, density, cost, fabricability, and availability are necessary but not sufficient; environmental conditions must be faced. The offshore is chemical and mechanical. Marine fouling, chemical and electrochemical corrosion, fatigue fracture, hydrogen-embrittlement cracking, stress-corrosion cracking, and brittle fracture are discussed. Two tables compare the properties of metals for offshore structures. General rules for safe design of corrosion-prone structures are: (1) specify the more cathodic metals for critical structural components, (2) strive for a high ratio of anodic to cathodic metal, (3) coat cathodic members, and (4) do not coat anodic members. (USBR)
W70-08673

SPECIAL REPORT: FOUR PROCESSES BOLSTER FUSION WELDING,
Materials Engineering, Stamford, Conn.
John A. Vaccari.
Materials Engineering, Vol 71, No 4, p 40-46, Apr 1970. 7 p, 14 fig.

Descriptors: *Welded joints, Welders, *Welding, Electron beams, Laser, Metals, Metalwork, Metal pipes, Butt joints, Joints, Fabrication, Arc welding.
Identifiers: Welds, *Electron-beam welding, *Laser welding, Gas metal-arc welding, *TIG welding, Narrow gap welding, *Fusion welding.

Substantial progress has been made in recent years with 4 relatively new welding processes: electron beam, laser, hot wire TIG, and narrow gap welding. Advantages of electron beam welding stem from the ability to focus large concentrations of energy on a minute spot. Extremely narrow and deep welds can be made at a single pass and at much higher speeds than can be achieved by arc welding. Electron beam is suitable for welding almost any joint, most metals, a wide variety of dissimilar metals, and many nonmetallic materials. Laser welding is still a specialty process, but is being used in the electronics industry. Welds can be made in any atmosphere and through transparent materials, such as inside vacuum tubes. Hot wire TIG welding has a deposition rate 3 to 5 times greater than conventional TIG welding, and is suitable for many steels and titanium and nickel alloys but is not recommended for aluminum and copper. A major commercial use is welding high-temperature, high-

pressure pipe. Narrow gap welding is a gas-shielded, multipass, metal arc process designed for narrow welds in 4- to 8-in.-thick plates of ferrous and nonferrous metals. This process has advantages from reduction of the weld size, substantial savings in weld materials, fast welding speeds, and minimal residual stresses and heat-affected zones. (USBR)
W70-08675

GATES AND RELATED OPERATING EQUIPMENT,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
For primary bibliographic entry see Field 08A.
W70-08684

8H. Rapid Excavation

EMISSION BY UNDERWATER EXPLOSIONS,
French Inst. of Petroleum, Paris.
For primary bibliographic entry see Field 07B.
W70-08585

RAPID-EXCAVATION CONCEPTS NOW IN FOCUS AS PARAMETERS AND DIMENSIONS EMERGE.

Engineering and Mining Journal, Vol 171, No 1, p 77-81, Jan 1970. 5 p, 3 fig.

Descriptors: *Tunneling, *Tunnel construction, Rock excavation, Costs, *Tunneling machines, Forecasting, Temperature, Automation, Research and development, Refrigeration, Gunite, *Boring machines, Tunnel pressures, Tunnel linings, Engineering geology.
Identifiers: *Rapid excavation, Tunnel supports, Raise boring, Rock pressures, Closed circuit television.

Faster tunneling at lower cost, in soft ground or hard rock, will be characteristic of mining and civil works in the next decade. Vast projects involving tunneling thousands of feet below the ground surface at phenomenal speeds will be possible. The present mode of stress relief and redistribution must be replaced by new methods. As tunneling speed is increased, tremendous increments of energy are expended in the tunnel, raising the temperature to dangerous levels. While refrigeration is the obvious answer, this may not be sufficient. Exhausting the hot air from the heading through an insulated pipe and conducting fresh refrigerated air in through another pipe may be necessary. Possibly, air will be taken into the heading in liquid form and evaporation will absorb the heat generated by the equipment. Another answer to some environmental problems is automation. The tunnel building process of the future could be almost completely automated and monitored by closed-circuit television. The labor force, other than the controllers, would be the troubleshooters and maintenance crews. Much research is in progress for developing techniques and machines for raise boring and tunneling. Some examples of these innovations are given. (USBR)
W70-08674

TUNNELING MACHINE S OF TODAY AND TOMORROW,
Jacobs Associates, San Francisco, Calif.
T. N. Williamson.
Report, National Academy of Sciences - Nat Research Council, Washington, D C, Jan 1970. 20 p, 5 fig, 10 ref.

Descriptors: *Tunneling, *Tunneling machines, Tunnel linings, Cutting, Tunnel construction, Forecasting, Underground structures, Reliability, Overbreak, Belt conveyors, Costs, Economics.
Identifiers: Tunnel supports, *Rapid excavation, Rock breakage, Cost savings, Cutters.
Much interest has been generated in tunnel boring by machine methods because of the increasing need for underground facilities. Developments in tunnel boring machine (TBM) are reviewed, beginning with the first uccessful operation in 1954 at Oahe Dam, S Dak, to the present time. More than half of the TBM applications have had at least a 40% time delay caused by inability to remove the excavated material as fast as it is produced; improvement in methods of concrete lining concurrently with boring is needed. Several advantages of tunnel boring machines are: (1) steel supports can be reduced to almost half, (2) concrete lining is reduced by 50% because of elimination of overbreak, and (3) lost time accidents are about 10% less than those on conventional tunnel jobs. Many developments are predicted for the TBM of the future. (USBR)
W70-08685

09. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

UNITED STATES WATER RESOURCES RESEARCH NEEDS,
Illinois Univ., Urbana. Coll. of Agriculture.
Roland R. Renne.
In: Proceedings of Symposium on Water Balance in North America, June 23-26, Banff, Alberta, Canada, American Water Resources Association, Urbana, Illinois, p 310-315, 1969.

Descriptors: *Water requirements, *United States, *Water resources development, *Research and development, Water balance, Water supply, Interbasin transfers, Planning, Research facilities.
Identifiers: *Water resources research.

U. S. overall water supply is considerably in excess of current use and projected demand in 1980 and 2000. Nevertheless, U.S. water problems are numerous, varied, and increasing. Approximately half of the nation will have very serious water problems in 1980 and acute problems in 2000 unless new approaches and significant adaptations of traditional ones are made. Only in the past five years has the U.S. embarked on a systematic, continuing, coordinated water resources research and planning program. Because of current budget and fiscal problems, available funds for needed research and planning are lagging behind recommended levels. Research objectives should be not only to improve methodology and criteria for more productive water resources planning and development but also to determine the kinds and precision of information needed and the analyses to evaluate alternatives. Several water research areas are described and related to current and prospective U.S. needs. (See also W70-08597)
W70-09003

9D. Grants, Contracts, and Research Act Allotments

FEDERAL GRANTS AVAILABLE FOR INDUSTRIAL POLLUTION CONTROL,
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05D.
W70-08969

10. SCIENTIFIC AND TECHNICAL INFORMATION

THE EFFECTS OF ELEVATED TEMPERATURE UPON AQUATIC INVERTEBRATES-A REVIEW OF LITERATURE RELATING TO FRESH WATER AND MARINE INVERTEBRATES,
Johns Hopkins Univ., Baltimore, Md. Dept. of Geography; and John Hopkins Univ., Baltimore, Md. Dept. of Environmental Engineering Science.
For primary bibliographic entry see Field 05C.
W70-08835

MICROFICHE VIEWING EQUIPMENT,
Defense Documentation Center, Alexandria, Va.
Ronald F. Gordon.
Available from the Clearinghouse as AD-701 600, $3.00 in paper copy, $0.65 in microfiche. Rept. No. DDC-TR-70-1, March, 1970, 55 p.

Descriptors: *Equipment.
Identifiers: *Microfiche, *Microforms, *Microfilm, Film viewers, Reader-printers, Reprography, Viewing equipment.

A descriptive directory is provided of microfiche readers and reader/printers manufactured in the features and specifications are provided for each of the 47 models surveyed. Viewer information is uniformly listed throughout the publication to aid comparison.
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Office of Saline Water	W70-08977	1

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